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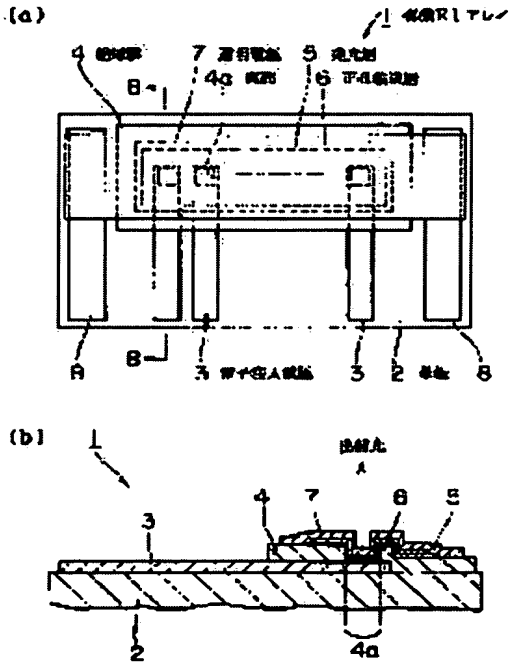
(54) ORGANIC ELECTROLUMINESCENT ARRAY

(57)Abstract:
PROBLEM TO BE SOLVED: To avoid a trouble at the time of mounting multiple LED chips in a straight line, and lower the cost by manufacturing organic electroluminescent arrays on an insulating board such as glass, which can be formed long and narrow, at the same time.
SOLUTION: An organic array 1 as a light source of a print head is provided with plural electron injection electrodes 3, an insulating film 4 a light emitting layer 5, a positive hole transporting layer 6 and a transparent electrode 7 on an insulating rectangular substrate 2 made of glass. A part of each electron injection electrode 3 is coated so as to form the insulating film 4, and the insulation film 4 is formed with a window 4a, which is formed into a square with a plane view, at a part just over each electron injection electrode 3. This window is formed per each electron injection electrode so that the organic electroluminescent array has multiple light emitting dots. Area for light emission can be accurately regulated by accurately performing the patterning of the window 4a of the insulating film 4.



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JAPANESE [JP,10-055890,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

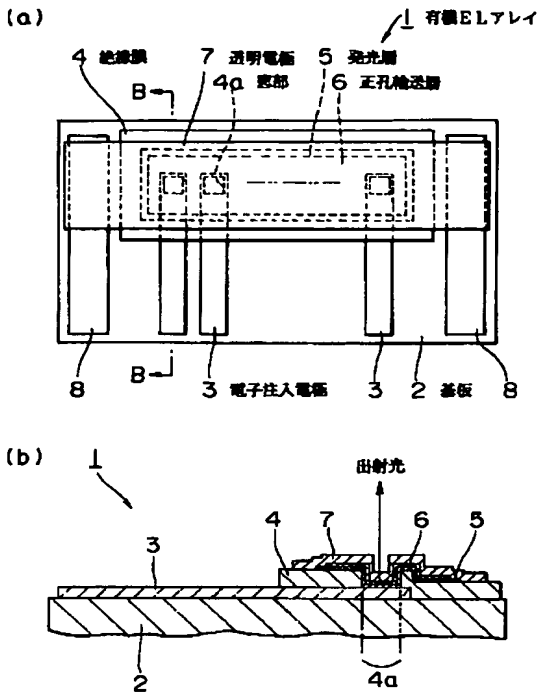
[Translation done.]

CLAIMS

[Claim(s)]
[Claim 1] Organic EL array which is characterized by providing the following and which has two or more luminescence dots An insulating substrate The electron-injection electrode of the aforementioned number of luminescence dots, and the abbreviation same number formed on this insulating substrate An insulator layer with the window part used as the luminescence dot which a part of each of these electron-injections electrode is covered, and it is formed on the aforementioned insulating substrate, and carries out opening in each right above section of this electron-injection electrode Transparent-electrode **** ** **** which covered the luminous layer formed in contact with each of an electron-injection electrode which covers the aforementioned window part and faces outside from the inside of this window part, the electron hole transporting bed which covered the right above position of the aforementioned window part, and was formed in contact with this on the aforementioned luminous layer, and this electron hole transporting bed and the aforementioned luminous layer, and was formed on the aforementioned insulating substrate in contact with this electron hole transporting bed
[Claim 2] Organic EL array characterized by establishing the crevice where the thickness becomes thin gradually the shape of the said heart toward the center of this window part at the portion located in the window part of the aforementioned insulator layer in the aforementioned electron-injection electrode in organic EL array according to claim 1.
[Claim 3] Organic EL array characterized by forming two or more thin parts with thin thickness in the portion located in the window part of the aforementioned insulator layer at the aforementioned electron-injection electrode compared with other parts in organic EL array according to claim 1.
[Claim 4] In organic EL array according to claim 1, the 2nd insulator layer is prepared between the aforementioned insulating substrate and an electron-injection electrode. to this 2nd insulator layer It is organic EL array which the crevice where the thickness becomes thin gradually the shape of the said heart toward the center of this window part at the portion located in the window part of the aforementioned insulator layer is prepared, and is characterized by the aforementioned electron-injection electrode serving as the configuration where the configuration of this crevice was met on the aforementioned crevice.
[Claim 5] It is organic EL array which the side of the insulator layer which forms the aforementioned electron-injection electrode and this window part is worn into the portion located in the window part of the aforementioned insulator layer at least in organic EL array according to claim 1, and the 2nd electron-injection electrode is prepared, and is characterized by for the aforementioned luminous layer having covered the electron-injection electrode of the above 2nd, and forming it.

[Translation done.]

Drawing selection [R pr sentativ drawing]



第１の実施形態例の概略構成図

[Translation done.]

JAPANESE [JP,10-055890,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[The technical field to which invention belongs] this invention relates to organic EL (electroluminescence) array used suitable for the optical printer head in an electrophotography formula printer.
[0002]
[Description of the Prior Art] as the light source of an electro photographic printer -- the former, for example, ", -- an LED array printer head which is indicated by Society of Electrophotography of Japan 31st page - 36th page; LED printer (Suzuki **** Takasu [Hiromi], Fukatsu ****)" is known [of the 2 volume / 24th / No. (1985)] Since the LED array which is the light source is solid-state-ized as a head and there is no mechanical mechanical component like a LASER beam printer, high reliability is acquired, and since the optical path length is still shorter, the LED printer equipped with such an LED array printer head can be miniaturized. Moreover, since the LED array is produced by the semiconductor manufacturing technology with a mass-production actual result, it can expect low-cost-ization by mass-production-izing.
[0003] At the LED printer indicated in the aforementioned reference, the printing process is advanced in the following sequence. First, an electrification machine is used for a photoconductor drum and a uniform charge is given. Next, a photoconductor drum side is made to carry out image formation of the light from an LED array through a convergence nature rod-lens array, and a latent image is formed. Subsequently, you imprint [which was used as the visible image with the developing machine] on the recording paper after that, and make it established. Furthermore, cleaning of a remains toner and electric discharge of a rest potential are performed, and a printing process is ended. In addition, what has a sensitivity property suitable for the luminescence wavelength of Light Emitting Diode also about a photoconductor drum is developed.
[0004] Moreover, the LED array printer head equipped with the LED array in this LED printer has the substrate which formed the thick-film pattern in the ceramic substrate of an alumina, arranges a Light Emitting Diode chip in on a straight line in the center section of this substrate, carries out die bond of the IC chip to the both sides with a conductive paste, and performs electrical installation with wire bond. A signal and a power supply are supplied to a ceramic substrate through a FPC (flexible printed circuit board) substrate. Moreover, it is decided by cutting precision of a chip whether a Light Emitting Diode chip will be continuously connectable.

[0005] By the way, three properties are demanded of the material of Light Emitting Diode.
a) It is three, that isolation of light is made, that the diffusion process in which b densification is possible can be used, and acquiring [the property stabilized at a c economical price] **, and now is taken by that GaAsP which carried out the vapor growth is the optimal on a GaAs substrate as what fills such a demand.

[0006] In order to manufacture such a Light Emitting Diode, a diffusion prevention film is formed in an n type GaAsP wafer by CVD etc., and a luminescence aperture is opened in this by the phot lithography method. Next, vacuum enclosure of a wafer and the P type impurity is carried out at quartz ampul, diffusion is performed at the temperature of about 700 degrees C for several hours, and a PN junction is formed in a luminescence aperture. At this time, 5-7 micrometers is suitable as the diffusion depth.
[0007] Subsequently, aluminum is turned on the P side, the vacuum evaporationo of the Au alloy is carried out to the N side, respectively, and an ohmic electrode is formed. A light-emitting part size is decided in general by density (resolution), and is set to 40 micrometers by mm in 16 dots (pitch 62.5micrometer) /with it. The number of dots per one chip has 64 dots or 128 practical dots by the chip yield and the size. Luminescence wavelength is decided by material and set to 660nm in this example.
[0008] In the present condition, from level [**10% of] to **40% is contained in 1 wafer, the quantity of light variation in 1 chip is sorted out by prober inspection, and **20% or less of thing is used. The cutting precision of a Light Emitting Diode chip influences array precision, and less than **5-micrometer highly precise cutting technology is needed. The scribe method using the cleavage is used about cutting for this connection.
[0009]
[Problem(s) to be Solved by the Invention] However, in the above-mentioned LED array print head, there is un-arranging [which is described below about the LED array]. Dispersion in the performance between the elements resulting from the defect which is inherent in a wafer, the heterogeneity of a manufacturing process, etc. is unescapable. Now substrates, such as GaAs used as the substrate of an LED array, can produce only a thing with a size of about at most 3 inches, but, moreover, are expensive. Furthermore, the yield will become bad, if there are many defects of a crystal and they make [many] the number of dots with a monolithic type.
[0010] Then, although much array chips of the few number of dots are made, these are connected and it is made to cover all recording widths, an array error arises in a chip connection in that case, and it will become it is large and difficult [mounting to a bird clapper etc. and a substrate / from] very much / this array error / as it becomes high-density. The difficulty on such mounting is the big factor which spoils low-cost-izing and densification. The place which this invention was made in view of the aforementioned situation, and is made into the purpose avoids the difficulty on mounting, and is to offer organic EL array which can attain low-cost-izing and densification.
[0011]
[Means for Solving the Problem] The electron-injection electrode of the number of luminescence dots, and the abbreviation same number formed on the insulating substrate and this insulating substrate in organic EL array of this invention, An insulator layer with the window part used as the luminescence dot which a part of each of these electron-injections electrode is covered, and it is formed on the aforementioned insulating substrate, and carries out opening in each right above section of this electron-injection electrode, The luminous layer formed in contact with each of an electron-injection electrode which covers the aforementioned window part and faces outside from the inside of this window part, It made into the solution means of the aforementioned technical problem to have had the transparent electrode which covered the electron hole transporting bed which covered the right above position of the aforementioned window part, and was formed in contact with this on the aforementioned luminous layer, and this electron hole transporting bed and the aforementioned luminous layer, and was formed on the aforementioned insulating substrate in contact with this electron hole transporting bed.
[0012] Since it is collectively produced on the insulating substrate in which things made long and slender, such as glass, are possible according to this organic EL array, the difficulty on mounting of making much Light Emitting Diode chips arrange on a straight line is avoided like the conventional LED array. Moreover, it becomes possible to abolish loss of the light by the total

reflection in a glass rear face which happens when taking out light from the rear face of the substrate which consists of glass, for example, sinc it considered as the structure which takes out light from the side which formed the window part of an insulator layer, i.e., the upper surface of an insulating substrate, and loss of the light by the absorption to glass, and to take out light outside efficiently.

[0013]

[Embodiments of the Invention] Hereafter, the example of an operation gestalt explains organic EL array of this invention in detail. Drawing 1 (a) and (b) are drawings showing the 1st example of an operation gestalt of this invention, and a sign 1 is organic EL array used as the light source of a print head in these drawings. This organic EL array 1 has many numbers of luminescence dots, with the insulation which consists of glass, on the substrate 2 of a rectangle tabular, is equipped with an insulator layer 4, a luminous layer 5, the electron hole transporting bed 6, and a transparent electrode 7, and is formed with two or more electron-injection electrode 3 --.

[0014] Electron-injection electrode 3 -- is a plane view rectangle-like thing, as shown in drawing 1 (a), is formed on the part substrate 2 of the number corresponding to the number of luminescence dots, and changes parallel into the state where set the predetermined interval, respectively and it was suitable in the direction of a shorter side of a substrate 2. As these electron-injections electrode 3 --, the low thing of a work function is desirable, it is specifically made suitable [a MgAg alloy, In, a MgIn alloy, a MgCu alloy, a MgLi alloy, etc.] so that easily [the electron injection to a luminous layer 5], in this example, a MgAg alloy is used and this is formed in 200nm in thickness.

[0015] Moreover, on the aforementioned substrate 2, a part of each aforementioned electron-injection electrode 3 -- is covered, and the insulator layer 4 is formed. Window part 4a which carries out opening to the shape of a plane view square in each right above section of aforementioned electron-injection electrode 3 -- is formed in this insulator layer 4. Window part 4a becomes a luminescence dot, and organic EL array becomes a thing with many luminescence dots by forming this window part 4a every electron-injection electrode 3. In addition, the reason which needs this insulator layer 4 is as follows.

[0016] Since a luminous layer 5 and the electron hole transporting bed 6 are organic films as mentioned later, the process of patterning using the phot lithography method cannot be borne, therefore this patterning cannot be performed. The field where a deer is carried out and the electron-injection electrode 3 and the luminous layer 5 formed on an insulator layer 4 touch must form the area correctly, when specifying the field where luminescence occurs. Then, after forming the electron-injection electrode 3, form the insulator layer 4 in which exact patterning is possible between this electron-injection electrode 3 and the luminous layer 5 formed in behind, and this is made to be placed between them. And by joining the electron-injection electrode 3 and a luminous layer 5 through window part 4a formed in the insulator layer 4 By performing correctly patterning of window part 4a of this insulator layer 4 can prescribe correctly the area of the field where the electron-injection electrode 3 and a luminous layer 5 touch, i.e., the field where luminescence occurs. It is desirable to form for such a reason from the material which can attain the fine patternizing by the phot lithography method as an insulator layer 4, and it is SiNx at this example. A film and SiOx A film etc. is used and this is formed in 300nm in thickness.

[0017] Moreover, on this insulator layer 4, the window part 4a is covered and the luminous layer 5 is formed. As this luminous layer 5 was mentioned above, it was formed in contact with each and electron-injection electrode 3 -- which faces outside from the inside of window part 4a of an insulator 4 consists of an organic film. It is also effective it to be desirable for the electron affinity to be 2.5eV or more, and it to specifically be supposed as this luminous layer 5, for that a metal chelate compound, polycyclic condensation or a conjugate aromatic hydrocarbon, benzoxazole or a benzothiazole derivative, a perylene system compound, a coumarin system

compound, etc. are suitable so that an electron may be easy to be poured in, and to dope fluorescence nature coloring matter, such as a pyran derivative, a coumarin derivative, a cyanine derivative, and a Quinacridone derivative, for wavelength control of luminescence or Moreover, the ionization potential of a luminous layer 5 must be lower than that of the electron hole transporting bed 6 so that the hole injection from the electron hole transporting bed 6 mentioned later to a luminous layer 5 may becom easy. And based on such conditions, this is formed in 50nm in thickness with the vacuum deposition by resistance heating by this example, using an eight-quinolinol aluminum complex (Alq3) as a luminous layer 5. In addition, the mask vacuum evaporationo to which the vacuum evaporationo only of the field to form in is carried out as this vacuum deposition was adopted.

[0018] On this luminous layer 5, the right above position of window part 4a of an insulator layer 4 is covered, and the electron hole transporting bed 6 is formed. As this electron hole transporting bed 6, ionization potential needs to be a thing with the electron-donative low molecule or the substituent, and it needs to be transparent to luminescence wavelength, and is specifically a triphenylamine derivative, and a benzidine type, a styryl amine type, a diamine type, etc. are made suitable. And in this example, a diamine derivative (TPD) is used and it is formed in 50nm in thickness by the vacuum deposition by resistance heating like the aforementioned luminous layer 5.

[0019] Moreover, on the aforementioned substrate 2, the electron hole transporting bed 6 and a luminous layer 5 are covered, and the transparent electrode 7 is formed in contact with the electron hole transporting bed 5. This transparent electrode 7 consists of what has permeability to a translucency, i.e., luminescence wavelength, and in order that it may make easy pouring of the electron hole to the electron hole transporting bed 6 which is an organic film so that it may mention later and, it is desirable that a work function is a large conductor, and it is formed in 150nm in thickness of the indium-stannic-acid ghost (ITO) in this example. Moreover, this transparent electrode 7 covers the electron hole transporting bed 6 and a luminous layer 5, and since the electron hole transporting bed 6 and a luminous layer 5 are organic films, is formed for preventing degradation by air contact of these organic film.

[0020] This transparent electrode 7 is electrically connected with the common electrode 8 arranged at the both sides of a substrate 2 as shown in drawing 1 (a). This common electrode 8 is formed simultaneously with the electron-injection electrode 3. And the organic EL array 1 is what sandwiched the luminous layer 5 and the electron hole transporting bed 6 between each electron-injection electrodes 3 and transparent electrodes 7 in the portion of window part 4a of an insulator layer 4 at the basis of such composition.

[0021] Next, the organic EL array 1 of such composition is explained with reference to drawing 2 about the example at the time of applying to a print head. In drawing 2 , a sign 1 is organic EL array shown in drawing 1 (a) and (b), and the substrate 2 of this organic EL array 1 is mounted on the drive circuit board 9 with the driver IC 10. As for the drive circuit board 9 and the driver IC 10, electrical installation is made by the bonding wire 11. Similarly, electrical installation is made by the bonding wire 11, respectively also about the substrate 2 of a driver IC 10 and the organic EL array 1 and the substrate 2 of the organic EL array 1, and the drive circuit board 9.

[0022] The convergence nature rod-lens array 12 and the photoconductor drum 13 are arranged in the upper part [of the organic EL array 1], i.e., the upper surface of substrate 2 of organic EL array 1, side by this order. And outgoing radiation of the light emitted from the organic EL array 1 on the basis of such composition is carried out to the upper surface side of a substrate 2, and it is condensed by the photoconductor drum 13 through the convergence nature rod-lens array 12.

[0023] Next, based on the composition of a print head shown in drawing 2 , operation of the organic EL array 1 shown in drawing 1 (a) and (b) is explained. First, in drawing 2 , the data of a content to print are sent to the driver IC 10 on the drive circuit board 9. Then, in the organic EL array 1 shown in drawing 1 (a) and (b), voltage is impressed so that data may become the

electron-injection electrode 3 with a negative potential at the dot (window part 4a) of "ON", in view of the common electrode 8. Here, "ON" and "OFF" are decided by existence of generating of the voltage difference between the electron-injection electrodes 3 and the common electrodes 8 by switch of two level of the applied voltage to the electron-injection electrode 3 set up beforehand.

[0024] In "ON", it operates as follows. Supply current is supplied to the common electrode 8 through a bonding wire 11, and flows to a transparent electrode 7 further. Consequently, the hole injection into the electron hole transporting bed 6 happens. On the other hand, the electron injection to a luminous layer 5 is similarly generated by the electron-injection electrode 3. The movement is blocked by the difference of the electron affinity of a luminous layer 5 and the electron hole transporting bed 6, when the electron poured into the luminous layer 5 moves toward the electron hole transporting bed 6 in the inside of a luminous layer 5 and an interface with the electron hole transporting bed 6 is arrived at.

[0025] However, if the electron hole poured into the electron hole transporting bed 6 moves toward the luminous layer 5 in the inside of the electron hole transporting bed 6 and arrives at an interface with a luminous layer 5, it is easily poured in into this luminous layer 5, and is recombined with the electron which was standing by there. And the excitation of an eight-quinolinol aluminum complex (Alq3) in which this recombination energy forms a luminous layer 8 is caused, and further, when returning from this excitation state to a ground state, fluorescence with a luminescence wavelength of 540nm is emitted.

[0026] The light by the side of a transparent electrode 7 penetrates a transparent electrode 7 as it is among the light generated by such mechanism, on the other hand, the light by the side of the electron-injection electrode 3 is reflected by this electron-injection electrode 3, and both are taken out by the upper surface shell exterior of a substrate. And as shown in drawing 2 , through the convergence nature rod-lens array 12, the light taken out by this exterior condenses to a photoconductor drum 13, and carries out required time irradiation. The point operates like the usual electrophotography method printer from here. In addition, since the potential difference does not have data between a transparent electrode 7 and the electron-injection electrode 3 at the dot (window part 4a) of "OFF", current does not flow and, thereby, luminescence does not take place by this dot.

[0027] Therefore, if it is in such an organic EL array 1, since it can produce collectively on one substrate 2, like the conventional LED array, the difficulty on mounting of making much Light Emitting Diode chips arrange on a straight line can be avoided, and low-cost-ization can be attained. Moreover, since it considered as the structure which takes out light from the upper surface side of a substrate 2, and loss of the light by the total reflection in a glass rear face which happens when taking out light from the rear face of the substrate which consists of glass, for example, and loss of the light by the absorption to glass can be abolished, light can be taken out outside efficiently and a strong light can be taken out by this in a short time, improvement in the speed of printing by the printer can be enabled.

[0028] Drawing 3 (a) and (b) are drawings showing the 2nd example of an operation gestalt of this invention, and a sign 20 is organic EL array in these drawings. The place where this organic EL array 20 differs from the organic EL array 1 shown in drawing 1 (a) and (b) is the point that crevice 21a to which the thickness becomes thin gradually the shape of the said heart toward the center of window part 4a of an insulator layer 4 at the electron-injection electrode 21 is prepared.

[0029] That is, crevice 21a stair-like into the portion located in window part 4a of an insulator layer 4 is formed in the electron-injection electrode 21 of the organic EL array 20 in this example of an operation form. This crevice 21a was taken toward the center of window part 4a of an insulator layer 4, the thickness of the electron-injection electrode 21 was thinly formed of the bird clapper stair-like gradually, and a plane view square-like crevice is dented and formed in two stages in this example, and the depression of these 2 stage is formed in the shape of the

said heart to the center of window part 4a. Here, the reason which can dent crevice 21a in the shape of the said heart is for making it a direction dependency not appear in the outgoing radiation intensity of light.

[0030] Moreover, in this crevice 21a, the field of the shape of drawing 3 (a) and a plane view square shown in [P] (b) serves as a portion which is a core and was formed most thinly, and the field of the shape of the field of the outside of this P field, i.e., drawing 3 , (a), and a plane view square frame shown in [Q] (b) serves as a portion formed thinly next. In this example of an operation form, thickness of the field shown by P which is the thinnest portion of a core was set to 100nm, and the level difference per step of the stairway in crevice 21a was set to 1 micrometer. Therefore, the thickness of the thickest portion of the electron-injection electrode 21 is set to 2.1 micrometers, and the thickness of the field shown by Q is set to 1.1 micrometers. In addition, about the configuration of such stair-like crevice 21a, since it is easily processible conventionally with a phot well-known lithography technology and etching technology, the explanation is omitted here.

[0031] After forming the electron-injection electrode 21 naturally and forming crevice 21a by ETCHIGGU further in manufacture of the organic EL array 20 with such an electron-injection electrode 21, formation of an insulator layer 4 and processing of the window part 4a are performed. And although a luminous layer 5, the electron hole transporting bed 6, and a transparent electrode 7 are formed one by one on it, since window part 4a of an insulator layer 4 is formed so that the aforementioned crevice 21a may be located in the interior, this crevice 21a will be exposed outside (upper surface side) within window part 4a. Therefore, by forming a luminous layer 5 in contact with this crevice 21a, as shown in drawing 3 (b), a stair-like crevice is seemingly formed also in this. Furthermore, an apparent stair-like crevice is similarly formed in the electron hole transporting bed 6 and a transparent electrode 7.

[0032] Thus, by forming crevice 21a in the electron-injection electrode 21, by the usual manufacture method, the rest is seen also in a luminous layer 5, the electron hole diffusion layer 6, and a transparent electrode 7, and can form the upper crevice. Therefore, compared with the thing of the 1st example of an operation gestalt, the surface area itself is large, from a bird clapper, the luminescence area also becomes large and, naturally, thereby, the luminous layer 5 especially formed in window part 4a of an insulator layer 4 can increase the total amount of the outgoing radiation light around unit time. And the total amount of the light which condenses to a photoconductor drum 13 through the convergence nature rod-lens array 12 as shown in drawing 2 can be increased by the ability increasing the total amount of outgoing radiation light in this way. That is, the total amount of the light around [which is condensed by the photoconductor drum 13] unit time can be increased by enlarging luminescence area.

[0033] This means that the luminescence time for performing printing for which it asks so that it may mention later can be shortened in printer head composition as shown in drawing 3 . However, you have to enlarge luminescence area, without enlarging window part 4a of an insulator layer 4 in enlarging luminescence area. because, window part 4a of an insulator layer 4 -- extending (it enlarging) -- it is because fixing of a toner will lap with the next dot and a quality of printed character will be spoiled, if the phenomenon separation of light becomes impossible between adjacent dots (window parts 4a and 4a) happens and such a phenomenon happens

[0034] In the organic EL array 20 of this example of an operation gestalt, without extending window part 4a of an insulator layer 4 by having formed crevice 21a in the electron-injection electrode 21, as mentioned above, it has structure which enlarged luminescence area, therefore can avoid un-arranging [that the aforementioned quality of printed character is spoiled]. The result which asked below for the ability of the organic EL array 20 of this example of an operation gestalt to shorten [how much luminescence time] by calculation is shown.

[0035] Total amount Pt of one luminescence dot (organic [EL]), i.e., the outgoing radiation light around unit time from one window part 4a, It is proportional to the luminescence area A. It is as

follows when this is expressed with a formula.
Pt =axA -- (1)
Here, a is the total amount of unit time and the outgoing radiation light per unit area, and is decided by the property organic [EL].
[0036] By the way, in the light source in the optical printer of an electrophotography method especially an LED array, or organic EL array of this invention, if the density of a luminescence dot is decided, the size of these luminescence dot and area will be decided almost automatically. It is because the phenomenon exposed to the next dot occurs if too small and it is [the amount of light itself decreases and] too large. Then, the area of the luminescence dot formed with the optimal size is fixed as S. This S corresponds to the area of window part 4a of an insulator layer 4 in this example of an operation gestalt. And it is Ps about the total amount of the outgoing radiation light around [which can be taken out from this S] unit time. If it carries out, since luminescence area can be increased in fixed S in this example of an operation gestalt, if the increment of the luminescence area by formation of crevice 21a is set to alpha, it is Ps about the total amount of outgoing radiation light. It can express as follows.
Ps =ax (S+alpha) -- (2)
[0037] Total amount Ps of the outgoing radiation light around [which is emitted from window part 4a of an insulator layer 4] unit time Inside, The total amount around [which the convergence nature rod-lens array 12 shown in drawing 2 is penetrated, and is further irradiated by the photoconductor drum 13] photometric-units time (luminescence power is called hereafter.) PD When efficiency in consideration of the probability which can carry out incidence to the convergence nature rod-lens array 12, the probability which can penetrate the convergence nature rod-lens array 12 is set to eta, it can express with the following formulas.
PD =Ps xeta -- (3)
Furthermore, it is as follows if a formula (2) is substituted for a formula (3).
PD =ax(S+alpha) xeta -- (4)
[0038] Next, when luminescence time is set to T, the total amount E of the light which contributes to exposure, i.e., exposure energy, can be expressed with the following formulas.
E=PD xT -- (5)
It is as follows if a formula (3) is substituted for a formula (5).
E=Ps x etaxT -- (6)
It is as follows if a formula (2) is substituted for a formula (6).
E=ax(S+alpha) x etaxT -- (7)
If this is expressed about T, it will become the following.
T=E/[axetax (S+alpha)] -- (8)
Moreover, since the total amount E of the light which contributes to exposure, i.e., exposure energy, is fixed, it is as follows.
T=K/(S+alpha) -- (9)
Here, K=E/[axeta is a constant.
[0039] Next, luminescence time explains concretely which was shortened by this example of an operation gestalt using a numeric value. A length of one sides of P [in / S=15micrometerx15micrometer=225micrometer2 and drawing 3 (b) / for the area (S) of window part 4a of an insulator layer 4] and Q was set to 5 micrometers and 10 micrometers. Therefore, the area (alpha) which increased by crevice 21a is set to alpha=1micrometer(level difference) x10micrometer(one-side length) x4(number of neighboring)+1micrometer(level difference) x5micrometer(one-side length) x4(number of neighboring) =60micrometer2.
[0040] Therefore, it is set to (S+alpha) / S= 1.27, and luminescence area becomes the increase of 27%. In addition, according to survey, it is the actual luminescence power PD. It was increasing about 50%. That is, it is actual PD although only an area increment increases due to a formula (4). It becomes large more than it is expressed with a formula (4). For the luminescence time T, this is not the formula (9) showing only the area effect but the actual luminescence

power PD. It is thought that it is because a formula (5) is followed since it is determined.
[0041] Thus, if it was in the organic EL array 20 of this example of an operation gestalt, since crevice 21a was formed in the electron-injection electrode 3, compared with the case where this is not formed, luminescence power can be increased 1.5 times, and, thereby, luminescence time can be shortened to 3 by about 2/. and luminescence time -- about -- it can be made two thirds -- time required for printing per line -- about -- the printing speed which it can be shortened to two thirds, therefore can be printed to around unit time can be increased about 1.5 times That is, in this example of an operation gestalt, printing speed can be directly made quick only by configuration processing of the electron-injection electrode 3. In addition, in this invention, if it is the configuration to which the thickness of the electron-injection electrode 3 becomes thin gradually the shape of the said heart toward the center of window part 4a of an insulator layer 4, without being limited to the configuration shown in drawing 3 (a) and (b) about the configuration of a crevice, of course, the configuration which has three or more steps of level differences, for example, the configuration gradually dented in the shape of a taper are sufficient.
[0042] Drawing 4 (a) and (b) are drawings showing the 3rd example of an operation gestalt of this invention, and a sign 30 is organic EL array in these drawings. The place where this organic EL array 30 differs from the organic EL array 1 shown in drawing 1 (a) and (b) is the point that four thin part 31a with thin thickness is formed in the electron-injection electrode 31 compared with other parts. That is, four thin part 31a is formed in the portion located in window part 4a of an insulator layer 4 at the electron-injection electrode 31 of the organic EL array 30 in this example of an operation gestalt. Thin part 31a is a plane view square-like thing, and as shown in drawing 4 (a), it is equally arranged from the center of this window part 4a at the four-corners section of window part 4a. Here, the reason which has arranged four thin part 31a equally from a center in this way is for making it a direction dependency not appear in the outgoing radiation intensity of light like the case of the 2nd example of an operation gestalt.
[0043] As for thin part 31a, the thickness is set to 100nm in the electron-injection electrode 3, and the level difference with other parts of the electron-injection electrode 3 is set to 1 micrometer. Namely, as for the electron-injection electrode 3, the thickness of parts other than thin part 31a is formed in 1.1 micrometers. In addition, since it is easily processible conventionally also about such thin part 31a with a phot well-known lithography technology and etching technology, the explanation is omitted.
[0044] Moreover, after forming the electron-injection electrode 21 naturally and forming crevice 21a by ETCHIGGU further in manufacture of the organic EL array 20 with such an electron-injection electrode 21, formation of an insulator layer 4 and processing of the window part 4a are performed. And although a luminous layer 5, the electron hole transporting bed 6, and a transparent electrode 7 are formed one by one on it, since window part 4a of an insulator layer 4 is formed so that the aforementioned crevice 21a may be located in the interior, this crevice 21a will be exposed outside (upper surface side) within window part 4a. Therefore, a luminous layer 5 is seen also in this, as by being formed in contact with this crevice 21a showed to drawing 3 (b), and the upper crevice is formed. Furthermore, an apparent crevice is similarly formed in the electron hole transporting bed 6 and a transparent electrode 7.
[0045] Moreover, like the example of an operation gestalt of the above 2nd, by forming thin part 31a-- in the electron-injection electrode 21 in this way, the rest is seen also in a luminous layer 5, the electron hole diffusion layer 6, and a transparent electrode 7, and can form the upper crevice by the usual manufacture method. Therefore, even if it is in this 3rd example of an operation gestalt, compared with the thing of the 1st example of an operation gestalt, the surface area itself is large, from a bird clapper, the luminescence area also becomes large and, naturally, thereby, the luminous layer 5 especially formed in window part 4a of an insulator layer 4 can increase the total amount of the outgoing radiation light around unit time. And even if it is in this 2nd example of operation gestalt organic EL array 30 by the ability increasing the total

amount of outgoing radiation light in this way, as mentioned above, the total amount of the light which condenses to a photoconductor drum 13 through the convergence nature rod-lens array 12 in the composition of drawing 2 can be increased, and the total amount of the light around [which is condensed by the photoconductor drum 13 by this] unit time can be increased.

[0046] The result which asked below for the ability of the organic EL array 30 of this xample of an operation gestalt to shorten [how much luminescence time] concretely by calculation using the numeric value like the case of the 2nd example of an operation gestalt is shown. A length [in / the plane view configuration of S=15micrometerx15micrometer=225micrometer2 and thin part 31a / for the area (S) of window part 4a of an insulator layer 4] of one side was set to 5 micrometers. Therefore, area which increased by four thin part 31a (alpha)
alpha=1micrometer(level difference) x5micrometer(one-side length) x4(number of neighboring) x4 (the number of thin parts)
= 80micrometer2 It becomes. Therefore, it is set to (S+alpha) / S= 1.36, and luminescence area becomes the increase of 36%. In addition, according to survey, it is the actual luminescence power PD. It was increasing about 70%. This is considered because the same effect as the case of the 2nd example of an operation gestalt has occurred.

[0047] Thus, if it was in the organic EL array 30 of this example of an operation gestalt, since thin part 31a-- was formed in the electron-injection electrode 3, compared with the case where this is not formed, luminescence power can be increased 1.7 times, and, thereby, luminescence time can be shortened to 5 by about 3/. and luminescence time -- about -- it can be made three fifths -- time required for printing per line -- about -- the printing speed which it can be shortened to three fifths, therefore can be printed to around unit time can be increased about 1.7 times That is, in this example of an operation gestalt, only by configuration processing of the electron-injection electrode 3, since printing speed can be directly made quick and four thin part 31a-- can moreover be once formed at an etching process, a process can be simplified and, thereby, low-cost-ization can also be attained. in addition, without it being alike and being limited to four about the number of thin part 31a, it is plurality, and if a manufacture top is possible, it is good in this invention, without limit

[0048] Drawing 5 (a) and (b) are drawings showing the 4th example of an operation form of this invention, and a sign 40 is organic EL array in these drawings. The place where this organic EL array 40 differs from the organic EL array 1 shown in drawing 1 (a) and (b) is the point that the 2nd insulator layer 41 is formed between a substrate 2 and the electron-injection electrode 3, and crevice 41a to which the thickness becomes thin stair-like gradually toward the center of window part 4a of an insulator layer 4 at this 2nd insulator layer 41 is prepared.

[0049] That is, formation of the electron-injection electrode 3 is preceded in the organic EL array 40 in this example of an operation form, and it is SiNX on a substrate 2. A film and SiOX The 2nd insulator layer 41 which consists of a film is formed. Crevice 41a of the same configuration as crevice 21a formed in the electron-injection electrode 21 in the 2nd example of an operation form is formed in this 2nd insulator layer 41. That is, this crevice 41a was also taken toward the center of window part 4a of an insulator layer 4 like the aforementioned crevice 21a, the thickness of the 2nd insulator layer 41 was thinly formed of the bird clapper stair-like gradually, and a plane view square-like crevice is dented and formed in two stages, and the depression of these 2 stage is formed in the shape of the said heart to the center of window part 4a. And the electron-injection electrode 3 is the thing of a configuration in alignment with the configuration of this crevice 41a by being formed on the 2nd insulator layer 41 in which such crevice 41a was formed.

[0050] In addition, also in this crevice 41a, the field of the shape of drawing 5 (a) and a plane view square shown in [P] (b) serves as a portion which is a core and was formed most thinly, and the field of the shape of the field of the outside of this P field, i.e., drawing 5 , (a), and a plane view square frame shown in [Q] (b) serves as a portion formed thinly next. And in this example of an operation form, thickness of the field shown by P was set to 100nm like crevice

21a in the 2nd example of an operation form, and the level difference per step of the stairway in crevice 41a was set to 1 micrometer. Therefore, the thickness of the thickest portion of the 2nd insulator layer 41 is set to 2.1 micrometers, and the thickness of the field shown by Q is set to 1.1 micrometers. About the configuration of such stair-like crevice 41a, since it is easily processible conventionally with a phot well-known lithography technology and etching technology, the explanation is omitted. Moreover, the reason which can dent crevice 41a in the shape of the said heart is for making it a direction dependency not appear in the outgoing radiation intensity of light like the 2nd example of an operation form.

[0051] As mentioned above, after forming the 2nd insulator layer 41 and forming crevice 41a by ETCHIGGU further in manufacture of the organic EL array 40 with such 2nd insulator layer 41, formation of the electron-injection electrode 3, formation of an insulator layer 4, and processing of the window part 4a are performed. At this time, as by being formed in contact with this crevice 41a showed the electron-injection electrode 3 to drawing 5 (b), a stair-like crevice is seemingly formed also in this. Subsequently, although a luminous layer 5, the electron hole transporting bed 6, and a transparent electrode 7 are formed one by one on an insulator layer 4, since window part 4a of an insulator layer 4 is formed so that the aforementioned crevice 41a may be located in the interior, the apparent crevice of the electron-injection electrode 3 formed on this crevice 41a will be exposed outside (upper surface side) within window part 4a. Therefore, a respectively apparent stair-like crevice is formed also in a luminous layer 5, the electron hole transporting bed 6, and a transparent electrode 7.

[0052] Thus, by forming crevice 41a in the 2nd insulator layer 41, by the usual manufacture method, the rest is seen also in the electron-injection electrode 3, a luminous layer 5, the electron hole diffusion layer 6, and a transparent electrode 7, and can form the upper crevice. Therefore, compared with the thing of the 1st example of an operation form, the surface area itself becomes large by the stair-like configuration and bird clapper corresponding to the configuration of crevice 41a in the luminous layer 5 especially formed in window part 4a of an insulator layer 4. Therefore, even if it is in the thing of this example of an operation form, greatly, from the bird clapper, the luminescence area can increase the total amount of the outgoing radiation light around unit time, and, naturally can increase the total amount of the light around [which is condensed by the photoconductor drum 13 in the composition which this showed to drawing 2] unit time.

[0053] In addition, it is easy to crystallize a luminous layer 5 and the electron hole transporting bed 6 in a portion with a level difference, and once it crystallizes these, the crystalline region will spread. And if this trespasses even upon a luminescence field, the portion will become the dark spot which does not emit light, will become what forms a point defect, and will spoil a quality of printed character remarkably. Therefore, as for an unnecessary level difference configuration, not giving as much as possible is desirable. In this example of an operation form, since the shape of toothing is formed only in the window part 4 of an insulator layer with the need of enlarging luminescence area, formation of the point defect accompanying crystallization of a luminous layer 5 or the electron hole transporting bed 6 can be suppressed to the minimum, and improvement in the yield can be aimed at.

[0054] The result which asked below for the ability of the organic EL array 40 of this example of an operation gestalt to shorten [how much luminescence time] concretely by calculation using the numeric value like the case of the 2nd example of an operation gestalt is shown. A length of one sides of P [area / (S) / of window part 4a of an insulator layer 4] in S= 15 micrometerx15-micrometer=225-micrometer 2 and drawing 5 (b) and Q was set to 5 micrometers and 10 micrometers. Therefore, the area (alpha) which increased by crevice 41a is set to alpha=1micrometer(level difference) x10micrometer(one-side length) x4(number of neighboring)+1micrometer(level difference) x5micrometer(one-side length) x4(number of neighboring) =60micrometer2. Therefore, it is set to (S+alpha) / S= 1.27, and luminescence area becomes the increase of 27%. In addition, according to survey, it is the actual luminescence

power PD. It was increasing about 50%. This is considered because the same effect as the case of the 2nd example of an operation gestalt has occurred.

[0055] Thus, if it was in the organic EL array 40 of this example of an operation gestalt, since crevice 41a was formed in the 2nd insulator layer 41, compared with the case wher this is not formed, luminescence power can be increased 1.5 times, and, thereby, luminescence time can be shortened to 3 by about 2/. and luminescence time -- about -- it can be made two thirds -- time required for printing per line -- about -- the printing speed which it can be shortened to two thirds, therefore can be printed to around unit time can be increased about 1.5 times That is, in this example of an operation gestalt, printing speed can be directly made quick only by configuration processing of the electron-injection electrode 3. In addition, in this invention, if it is the configuration to which the thickness of the 2nd insulator layer 4 becomes thin gradually the shape of the said heart toward the center of window part 4a of an insulator layer 4, without being limited to the configuration shown in drawing 5 (a) and (b) about the configuration of a crevice, of course, the configuration which has three or more steps of level differences, for example, the configuration gradually dented in the shape of a taper are sufficient.

[0056] Drawing 6 (a) and (b) are drawings showing the 5th example of an operation form of this invention, and a sign 50 is organic EL array in these drawings. The place where this organic EL array 50 differs from the organic EL array 1 shown in drawing 1 (a) and (b) the side of the insulator layer 4 which forms each electron-injection electrode 3 and this window part 4a is worn into the portion located in window part 4a of an insulator layer 4, and the 2nd electron-injection electrode 51 prepares in it -- having -- a luminous layer 5 -- this -- it is the point which covers the 2nd electron-injection electrode 51 and is formed

[0057] Namely, it sets to the organic EL array 50 in this example of an operation gestalt. After forming electron-injection electrode 3 and forming an insulator layer 4 and its window part 4a further, in contact with the side of the insulator layer 4 which covers this in contact with the electron-injection electrode 3, and forms window part 4a, the insulator layer 4 for a periphery of this window part 4a is also covered for this with a wrap, and the 2nd electron-injection electrode 51 is formed. As this 2nd electron-injection electrode 51, the low thing of a work function is desirable, it is specifically made suitable [a MgAg alloy, In, a MgIn alloy, a MgCu alloy, a MgLi alloy, etc.] so that easily [the electron injection to a luminous layer 5], in this example, a MgAg alloy is used and this is formed in 100nm in thickness. However, in this example of an operation gestalt, since it stops being almost related to the electron injection to a luminous layer 5 about the electron-injection electrode 3, a work function does not need to consider as a low thing, therefore aluminum is used.

[0058] If it is in the organic EL array 50 of this example of an operation form Since the side of the insulator layer 4 which forms each electron-injection electrode 3 and this window part 4a for the 2nd electron-injection electrode 51 was worn and formed Also in the window part 4a side of the insulator layer 4 which causes optical leakage in window part 4a especially, by covering this by the 2nd electron-injection electrode 51, it reflects without the generated light leaking on this side, and is taken out as an outgoing radiation light. Consequently, total amount PS of outgoing radiation light It can enlarge.

[0059] The result which asked below for the ability of the organic EL array 50 of this example of an operation form to shorten [how much luminescence time] concretely by calculation using the numeric value like the case of the 2nd example of an operation form is shown. The amount of the light which it is newly reflected by the 2nd electron-injection electrode 51, and can be taken out outside as an outgoing radiation light is equivalent to the following reflector product increase parts beta.

a part for reflector product increase -- beta=0.3micrometer(thickness of insulator layer) x15micrometer(one-side length of window part) x4(number of neighboring) =18micrometer2 -- here, PD2 is as follows when luminescence power obtained when only beta increases a reflector product is set to PD2

Although PD2=PD / (S+beta) S=1.08P luminescence area does not change, a reflector product becomes the increase of 8%. In addition, according to survey, the actual lumin scence power PD 2 was increasing about 20%. here -- it should observe -- it is the point which has not changed luminescence area If luminescence area becomes large, luminescence power will go up, and [instead] you also have to increase supply current. However, luminescence power can be raised in this example of an operation gestalt, without increasing supply current, since luminescence power can be raised without enlarging luminescence area.

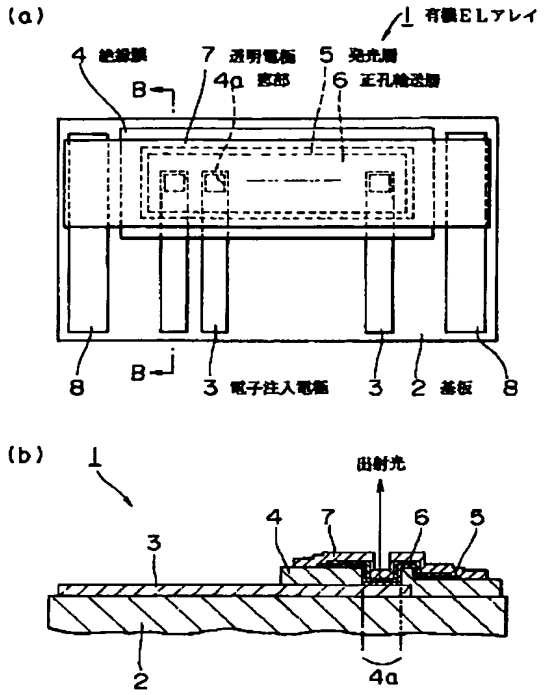
[0060] Thus, if it was in the organic EL array 50 of this example of an operation gestalt, since the side of the insulator layer 4 which forms each electron-injection electrode 3 and this window part 4a for the 2nd electron-injection electrode 51 was worn and formed, compared with the case where this is not formed, luminescence power can be increased 1.2 times, and, thereby, luminescence time can be shortened to 5 by about 4/. and luminescence time -- about -- it can be made four fifths -- time required for printing per line -- about -- the printing speed which it can be shortened to four fifths, therefore can be printed to around unit time can be increased about 1.2 times Moreover, since luminescence power can be raised in this example of an operation gestalt, without increasing supply current, luminous efficiency can be improved and, thereby, reduction-ization of the consumed electric current can be attained.

[0061]

[Effect of the Invention] As explained above, since organic EL array of this invention can be put in block on an insulating substrate and can be produced, like the conventional LED array, it can avoid the difficulty on mounting of making much Light Emitting Diode chips arrange on a straight line, and, thereby, can attain low-cost-ization. Moreover, since it considered as the structure which takes out light from the side which formed the window part of an insulator layer, i.e., the upper surface of an insulating substrate For example, loss of the light by the total reflection in a glass rear face which happens when taking out light from the rear face of the substrate which consists of glass, Since loss of the light by the absorption to glass can be abolished, light can be taken out outside efficiently and a strong light can be taken out by this in a short time, improvement in the speed of printing by the printer can be enabled.

[Translation done.]

Drawing selection [Representativ drawing]



第１の実施形態例の概略構成図

[Translation done.]

JAPANESE [JP,10-055890,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

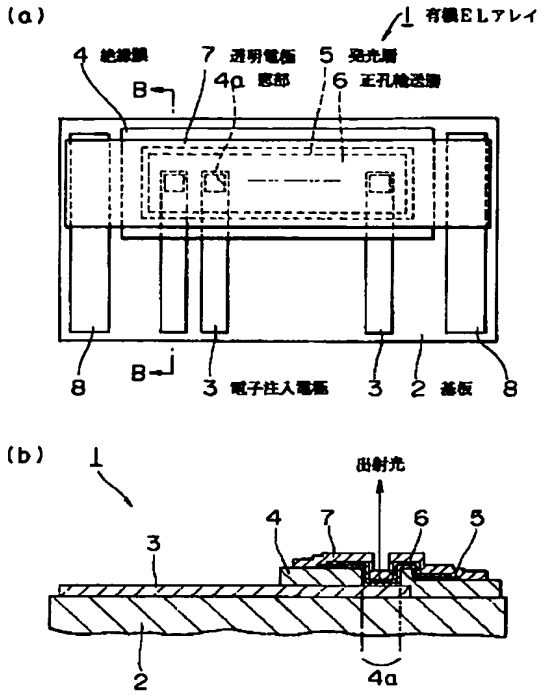
[Translation done.]

TECHNICAL FIELD

[The technical field to which invention belongs] this invention relates to organic EL (electroluminescence) array used suitable for the optical printer head in an electrophotography formula printer.

[Translation done.]

Drawing selection [Representative drawing]



第１の実施形態例の概略構成図

[Translation done.]

JAPANESE [JP,10-055890,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

PRIOR ART

[Description of the Prior Art] as the light source of an electro photographic printer -- the former, for example, ", -- an LED array printer head which is indicated by Society of Electrophotography of Japan 31st page - 36th page; LED printer (Suzuki **** Takasu [Hiromi], Fukatsu ****)" is known [of the 2 volume / 24th / No. (1985)] Since the LED array which is the light source is solid-state-ized as a head and there is no mechanical mechanical component like a LASER beam printer, high reliability is acquired, and since the optical path length is still shorter, the LED printer equipped with such an LED array printer head can be miniaturized. Moreover, since the LED array is produced by the semiconductor manufacturing technology with a mass-production actual result, it can expect low-cost-ization by mass-production-izing.
[0003] At the LED printer indicated in the aforementioned reference, the printing process is advanced in the following sequence. First, an electrification machine is used for a photoconductor drum and a uniform charge is given. Next, a photoconductor drum side is made to carry out image formation of the light from an LED array through a convergence nature rod-lens array, and a latent image is formed. Subsequently, you imprint [which was used as the visible image with the developing machine] on the recording paper after that, and make it established. Furthermore, cleaning of a remains toner and electric discharge of a rest potential are performed, and a printing process is ended. In addition, what has a sensitivity property suitable for the luminescence wavelength of Light Emitting Diode also about a photoconductor drum is developed.
[0004] Moreover, the LED array printer head equipped with the LED array in this LED printer has the substrate which formed the thick-film pattern in the ceramic substrate of an alumina, arranges a Light Emitting Diode chip in on a straight line in the center section of this substrate, carries out die bond of the IC chip to the both sides with a conductive paste, and performs electrical installation with wire bond. A signal and a power supply are supplied to a ceramic substrate through a FPC (flexible printed circuit board) substrate. Moreover, it is decided by cutting precision of a chip whether a Light Emitting Diode chip will be continuously connectable.

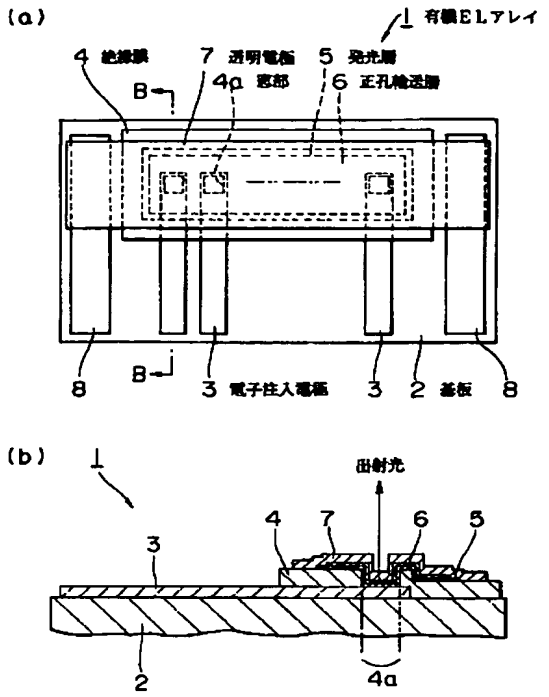
[0005] By the way, three properties are demanded of the material of Light Emitting Diode.
a) It is three, that isolation of light is made, that the diffusion process in which b densification is possible can be used, and acquiring [the property stabilized at a c economical price] **, and now is taken by that GaAsP which carried out the vapor growth is the optimal on a GaAs substrate as what fills such a demand.
[0006] In order to manufacture such a Light Emitting Diode, a diffusion prevention film is formed in an n type GaAsP wafer by CVD etc., and a luminescence aperture is opened in this by the phot lithography method. Next, vacuum enclosure of a wafer and the P type impurity is carried out at quartz ampul, diffusion is performed at the temperature of about 700 degrees C for several hours, and a PN junction is formed in a luminescence aperture. At this time, 5-7 micrometers is suitable as the diffusion depth.

[0007] Subsequently, aluminum is turned on the P side, the vacuum evaporationo of the Au alloy is carried out to the N side, respectively, and an ohmic electrode is formed. A light-emitting part size is decided in general by density (resolution), and is set to 40 micrometers by mm in 16 dots (pitch 62.5micrometer) /with it. The number of dots per one chip has 64 dots or 128 practical dots by the chip yield and the size. Luminescence wavelength is decided by material and set to 660nm in this example.

[0008] In the present condition, from level [**10% of] to **40% is contained in 1 wafer, the quantity of light variation in 1 chip is sorted out by prober inspection, and **20% or less of thing is used. The cutting precision of a Light Emitting Diode chip influences array precision, and less than **5-micrometer highly precise cutting technology is needed. The scribe method using the cleavage is used about cutting for this connection.

[Translation done.]

Drawing selection [R pr sentativ drawing]



第１の実施形態例の概略構成図

[Translation done.]

JAPANESE [JP,10-055890,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

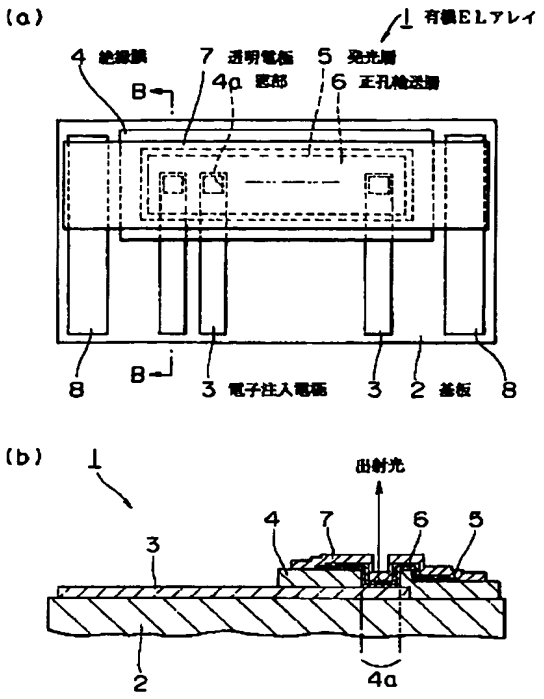
[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] As explained above, since organic EL array of this invention can be put in block on an insulating substrate and can be produced, like the conventional LED array, it can avoid the difficulty on mounting of making much Light Emitting Diode chips arrange on a straight line, and, thereby, can attain low-cost-ization. Moreover, it is since it considered as the structure which takes out light from the side which formed the window part of an insulator layer, i.e., the upper surface of an insulating substrate. For example, since loss of the light by the total reflection in a glass rear face which happens when taking out light from the rear face of the substrate which consists of glass, and loss of the light by the absorption to glass can be abolished, light can be taken out outside efficiently and a strong light can be taken out by this in a short time, improvement in the speed of printing by the printer can be enabled.

[Translation done.]

Drawing selection [Repres ntative drawing]



第１の実施形態例の概略構成図

[Translation done.]

JAPANESE [JP,10-055890,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

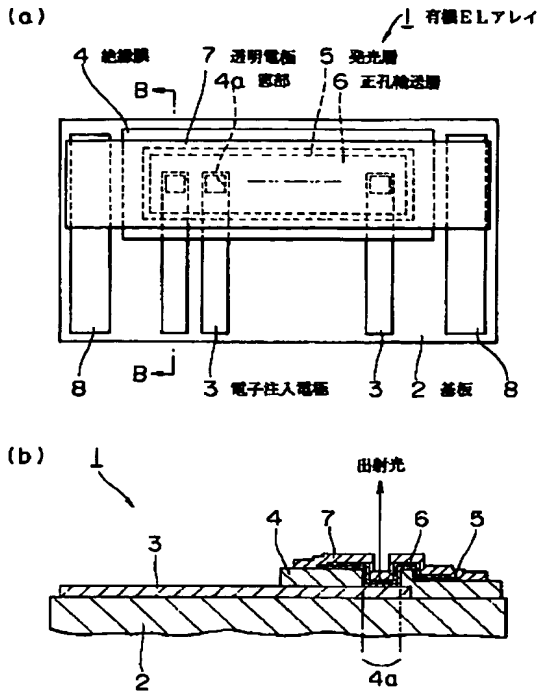
[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, in the above-mentioned LED array print head, there is un-arranging [which is described below about the LED array]. Dispersion in the performance between the elements resulting from the defect which is inherent in a wafer, the heterogeneity of a manufacturing process, etc. is unescapable. Now substrates, such as GaAs used as the substrate of an LED array, can produce only a thing with a size of about at most 3 inches, but, moreover, are expensive. Furthermore, the yield will become bad, if there are many defects of a crystal and they make [many] the number of dots with a monolithic type.
[0010] Then, although much array chips of the few number of dots are made, these are connected and it is made to cover all recording widths, an array error arises in a chip connection in that case, and it will become it is large and difficult [mounting to a bird clapper etc. and a substrate / from] very much / this array error / as it becomes high-density. The difficulty on such mounting is the big factor which spoils low-cost-izing and densification. The place which this invention was made in view of the aforementioned situation, and is made into the purpose avoids the difficulty on mounting, and is to offer organic EL array which can attain low-cost-izing and densification.

[Translation done.]

Drawing selection [R presentative drawing]



第１の実施形態例の概略構成図

[Translation done.]

JAPANESE [JP,10-055890,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

MEANS

[Means for Solving the Problem] The electron-injection electrode of the number of luminescence dots, and the abbreviation same number formed on the insulating substrate and this insulating substrate in organic EL array of this invention, An insulator layer with the window part used as the luminescence dot which a part of each of these electron-injections electrode is covered, and it is formed on the aforementioned insulating substrate, and carries out opening in each right above section of this electron-injection electrode, The luminous layer formed in contact with each of an electron-injection electrode which covers the aforementioned window part and faces outside from the inside of this window part, It made into the solution means of the aforementioned technical problem to have had the transparent electrode which covered the electron hole transporting bed which covered the right above position of the aforementioned window part, and was formed in contact with this on the aforementioned luminous layer, and this electron hole transporting bed and the aforementioned luminous layer, and was formed on the aforementioned insulating substrate in contact with this electron hole transporting bed.
[0012] Since it is collectively produced on the insulating substrate in which things made long and slender, such as glass, are possible according to this organic EL array, the difficulty on mounting of making much Light Emitting Diode chips arrange on a straight line is avoided like the conventional LED array. Moreover, it becomes possible to abolish loss of the light by the total reflection in a glass rear face which happens when taking out light from the rear face of the substrate which consists of glass, for example, since it considered as the structure which takes out light from the side which formed the window part of an insulator layer, i.e., the upper surface of an insulating substrate, and loss of the light by the absorption to glass, and to take out light outside efficiently.
[0013]
[Embodiments of the Invention] Hereafter, the example of an operation gestalt explains organic EL array of this invention in detail. Drawing 1 (a) and (b) are drawings showing the 1st example of an operation gestalt of this invention, and a sign 1 is organic EL array used as the light source of a print head in these drawings. This organic EL array 1 has many numbers of luminescence dots, with the insulation which consists of glass, on the substrate 2 of a rectangle tabular, is equipped with an insulator layer 4, a luminous layer 5, the electron hole transporting bed 6, and a transparent electrode 7, and is formed with two or more electron-injection electrode 3 --.
[0014] Electron-injection electrode 3 -- is a plane view rectangle-like thing, as shown in drawing 1 (a), is formed on the part substrate 2 of the number corresponding to the number of luminescence dots, and changes parallel into the state where set the predetermined interval, respectively and it was suitable in the direction of a shorter side of a substrate 2. As these electron-injections electrode 3 --, the low thing of a work function is desirable, it is specifically made suitable [a MgAg alloy, In, a MgIn alloy, a MgCu alloy, a MgLi alloy, etc.] so that easily [the electron injection to a luminous layer 5], in this example, a MgAg alloy is used and this is

formed in 200nm in thickness.

[0015] Moreover, on the aforementioned substrate 2, a part of each aforementioned electron-injection electrode 3 -- is covered, and the insulator layer 4 is formed. Window part 4a which carries out opening to the shape of a plane view square in each right above section of aforementioned electron-injection electrode 3 -- is formed in this insulator layer 4. Window part 4a becomes a luminescence dot, and organic EL array becomes a thing with many luminescence dots by forming this window part 4a every electron-injection electrode 3. In addition, the reason which needs this insulator layer 4 is as follows.

[0016] Since a luminous layer 5 and the electron hole transporting bed 6 are organic films as mentioned later, the process of patterning using the phot lithography method cannot be borne, therefore this patterning cannot be performed. The field where a deer is carried out and the electron-injection electrode 3 and the luminous layer 5 formed on an insulator layer 4 touch must form the area correctly, when specifying the field where luminescence occurs. Then, after forming the electron-injection electrode 3, form the insulator layer 4 in which exact patterning is possible between this electron-injection electrode 3 and the luminous layer 5 formed in behind, and this is made to be placed between them. And by joining the electron-injection electrode 3 and a luminous layer 5 through window part 4a formed in the insulator layer 4 By performing correctly patterning of window part 4a of this insulator layer 4 can prescribe correctly the area of the field where the electron-injection electrode 3 and a luminous layer 5 touch, i.e., the field where luminescence occurs. It is desirable to form for such a reason from the material which can attain the fine patternizing by the phot lithography method as an insulator layer 4, and it is SiNx at this example. A film and SiOx A film etc. is used and this is formed in 300nm in thickness.

[0017] Moreover, on this insulator layer 4, the window part 4a is covered and the luminous layer 5 is formed. As this luminous layer 5 was mentioned above, it was formed in contact with each and electron-injection electrode 3 -- which faces outside from the inside of window part 4a of an insulator 4 consists of an organic film. It is also effective it to be desirable for the electron affinity to be 2.5eV or more, and it to specifically be supposed as this luminous layer 5, for that a metal chelate compound, polycyclic condensation or a conjugate aromatic hydrocarbon, benzoxazole or a benzothiazole derivative, a perylene system compound, a coumarin system compound, etc. are suitable so that an electron may be easy to be poured in, and to dope fluorescence nature coloring matter, such as a pyran derivative, a coumarin derivative, a cyanine derivative, and a Quinacridone derivative, for wavelength control of luminescence or Moreover, the ionization potential of a luminous layer 5 must be lower than that of the electron hole transporting bed 6 so that the hole injection from the electron hole transporting bed 6 mentioned later to a luminous layer 5 may become easy. And based on such conditions, this is formed in 50nm in thickness with the vacuum deposition by resistance heating by this example, using an eight-quinolinol aluminum complex (Alq3) as a luminous layer 5. In addition, the mask vacuum evaporationo to which the vacuum evaporationo only of the field to form in is carried out as this vacuum deposition was adopted.

[0018] On this luminous layer 5, the right above position of window part 4a of an insulator layer 4 is covered, and the electron hole transporting bed 6 is formed. As this electron hole transporting bed 6, ionization potential needs to be a thing with the electron-donative low molecule or the substituent, and it needs to be transparent to luminescence wavelength, and is specifically a triphenylamine derivative, and a benzidine type, a styryl amine type, a diamine type, etc. are made suitable. And in this example, a diamine derivative (TPD) is used and it is formed in 50nm in thickness by the vacuum deposition by resistance heating like the aforementioned luminous layer 5.

[0019] Moreover, on the aforementioned substrate 2, the electron hole transporting bed 6 and a luminous layer 5 are covered, and the transparent electrode 7 is formed in contact with the electron hole transporting bed 5. This transparent electrode 7 consists of what has permeability

to a translucency, i.e., luminescence wavelength, and in order that it may make easy pouring of the electron hole to the electron hole transporting bed 6 which is an organic film so that it may mention later and, it is desirable that a work function is a large conductor, and it is formed in 150nm in thickness of the indium-stannic-acid ghost (ITO) in this example. Moreover, this transparent electrode 7 covers the electron hole transporting bed 6 and a luminous layer 5, and since the electron hole transporting bed 6 and a luminous layer 5 are organic films, is formed for preventing degradation by air contact of these organic film.

[0020] This transparent electrode 7 is electrically connected with the common electrode 8 arranged at the both sides of a substrate 2 as shown in drawing 1 (a). This common electrode 8 is formed simultaneously with the electron-injection electrode 3. And the organic EL array 1 is what sandwiched the luminous layer 5 and the electron hole transporting bed 6 between each electron-injection electrodes 3 and transparent electrodes 7 in the portion of window part 4a of an insulator layer 4 at the basis of such composition.

[0021] Next, the organic EL array 1 of such composition is explained with reference to drawing 2 about the example at the time of applying to a print head. In drawing 2 , a sign 1 is organic EL array shown in drawing 1 (a) and (b), and the substrate 2 of this organic EL array 1 is mounted on the drive circuit board 9 with the driver IC 10. As for the drive circuit board 9 and the driver IC 10, electrical installation is made by the bonding wire 11. Similarly, electrical installation is made by the bonding wire 11, respectively also about the substrate 2 of a driver IC 10 and the organic EL array 1 and the substrate 2 of the organic EL array 1, and the drive circuit board 9.

[0022] The convergence nature rod-lens array 12 and the photoconductor drum 13 are arranged in the upper part [of the organic EL array 1], i.e., the upper surface of substrate 2 of organic EL array 1, side by this order. And outgoing radiation of the light emitted from the organic EL array 1 on the basis of such composition is carried out to the upper surface side of a substrate 2, and it is condensed by the photoconductor drum 13 through the convergence nature rod-lens array 12.

[0023] Next, based on the composition of a print head shown in drawing 2 , operation of the organic EL array 1 shown in drawing 1 (a) and (b) is explained. First, in drawing 2 , the data of a content to print are sent to the driver IC 10 on the drive circuit board 9. Then, in the organic EL array 1 shown in drawing 1 (a) and (b), voltage is impressed so that data may become the electron-injection electrode 3 with a negative potential at the dot (window part 4a) of "ON", in view of the common electrode 8. Here, "ON" and "OFF" are decided by existence of generating of the voltage difference between the electron-injection electrodes 3 and the common electrodes 8 by switch of two level of the applied voltage to the electron-injection electrode 3 set up beforehand.

[0024] In "ON", it operates as follows. Supply current is supplied to the common electrode 8 through a bonding wire 11, and flows to a transparent electrode 7 further. Consequently, the hole injection into the electron hole transporting bed 6 happens. On the other hand, the electron injection to a luminous layer 5 is similarly generated by the electron-injection electrode 3. The movement is blocked by the difference of the electron affinity of a luminous layer 5 and the electron hole transporting bed 6, when the electron poured into the luminous layer 5 moves toward the electron hole transporting bed 6 in the inside of a luminous layer 5 and an interface with the electron hole transporting bed 6 is arrived at.

[0025] However, if the electron hole poured into the electron hole transporting bed 6 moves toward the luminous layer 5 in the inside of the electron hole transporting bed 6 and arrives at an interface with a luminous layer 5, it is easily poured in into this luminous layer 5, and is recombined with the electron which was standing by there. And the excitation of an eight-quinolinol aluminum complex (Alq3) in which this recombination energy forms a luminous layer 8 is caused, and further, when returning from this excitation state to a ground state, fluorescence with a luminescence wavelength of 540nm is emitted.

[0026] The light by the side of a transparent electrode 7 penetrates a transparent electrode 7

as it is among the light generated by such mechanism, on the other hand, the light by the side of the electron-injection electrode 3 is reflected by this electron-injection electrode 3, and both are taken out by the upper surfac shell exterior of a substrate. And as shown in drawing 2 , through the convergence nature rod-lens array 12, the light taken out by this exterior condenses to a photoconductor drum 13, and carries out required time irradiation. The point operates like the usual electrophotography method printer from here. In addition, since the potential difference does not have data between a transparent electrode 7 and the electron-injection electrode 3 at the dot (window part 4a) of "OFF", current does not flow and, thereby, luminescence does not take place by this dot.

[0027] Therefore, if it is in such an organic EL array 1, since it can produce collectively on one substrate 2, like the conventional LED array, the difficulty on mounting of making much Light Emitting Diode chips arrange on a straight line can be avoided, and low-cost-ization can be attained. Moreover, since it considered as the structure which takes out light from the upper surface side of a substrate 2, and loss of the light by the total reflection in a glass rear face which happens when taking out light from the rear face of the substrate which consists of glass, for example, and loss of the light by the absorption to glass can be abolished, light can be taken out outside efficiently and a strong light can be taken out by this in a short time, improvement in the speed of printing by the printer can be enabled.

[0028] Drawing 3 (a) and (b) are drawings showing the 2nd example of an operation gestalt of this invention, and a sign 20 is organic EL array in these drawings. The place where this organic EL array 20 differs from the organic EL array 1 shown in drawing 1 (a) and (b) is the point that crevice 21a to which the thickness becomes thin gradually the shape of the said heart toward the center of window part 4a of an insulator layer 4 at the electron-injection electrode 21 is prepared.

[0029] That is, crevice 21a stair-like into the portion located in window part 4a of an insulator layer 4 is formed in the electron-injection electrode 21 of the organic EL array 20 in this example of an operation form. This crevice 21a was taken toward the center of window part 4a of an insulator layer 4, the thickness of the electron-injection electrode 21 was thinly formed of the bird clapper stair-like gradually, and a plane view square-like crevice is dented and formed in two stages in this example, and the depression of these 2 stage is formed in the shape of the said heart to the center of window part 4a. Here, the reason which can dent crevice 21a in the shape of the said heart is for making it a direction dependency not appear in the outgoing radiation intensity of light.

[0030] Moreover, in this crevice 21a, the field of the shape of drawing 3 (a) and a plane view square shown in [P] (b) serves as a portion which is a core and was formed most thinly, and the field of the shape of the field of the outside of this P field, i.e., drawing 3 , (a), and a plane view square frame shown in [Q] (b) serves as a portion formed thinly next. In this example of an operation gestalt, thickness of the field shown by P which is the thinnest portion of a core was set to 100nm, and the level difference per step of the stairway in crevice 21a was set to 1 micrometer. Therefore, the thickness of the thickest portion of the electron-injection electrode 21 is set to 2.1 micrometers, and the thickness of the field shown by Q is set to 1.1 micrometers. In addition, about the configuration of such stair-like crevice 21a, since it is easily processible conventionally with a phot well-known lithography technology and etching technology, the explanation is omitted here.

[0031] After forming the electron-injection electrode 21 naturally and forming crevice 21a by ETCHIGGU further in manufacture of the organic EL array 20 with such an electron-injection electrode 21, formation of an insulator layer 4 and processing of the window part 4a are performed. And although a luminous layer 5, the electron hole transporting bed 6, and a transparent electrode 7 are formed one by one on it, since window part 4a of an insulator layer 4 is formed so that the aforementioned crevice 21a may be located in the interior, this crevice 21a will be exposed outside (upper surface side) within window part 4a. Therefore, by forming a

luminous layer 5 in contact with this crevice 21a, as shown in drawing 3 (b), a stair-like crevice is seemingly formed also in this. Furthermore, an apparent stair-like crevice is similarly formed in the electron hole transporting bed 6 and a transparent electrode 7.

[0032] Thus, by forming crevice 21a in the electron-injection electrode 21, by the usual manufacture method, the rest is seen also in a luminous layer 5, the electron hole diffusion layer 6, and a transparent electrode 7, and can form the upper crevice. Therefore, compared with the thing of the 1st example of an operation gestalt, the surface area itself is large, from a bird clapper, the luminescence area also becomes large and, naturally, thereby, the luminous layer 5 especially formed in window part 4a of an insulator layer 4 can increase the total amount of the outgoing radiation light around unit time. And the total amount of the light which condenses to a photoconductor drum 13 through the convergence nature rod-lens array 12 as shown in drawing 2 can be increased by the ability increasing the total amount of outgoing radiation light in this way. That is, the total amount of the light around [which is condensed by the photoconductor drum 13] unit time can be increased by enlarging luminescence area.

[0033] This means that the luminescence time for performing printing for which it asks so that it may mention later can be shortened in printer head composition as shown in drawing 3 . However, you have to enlarge luminescence area, without enlarging window part 4a of an insulator layer 4 in enlarging luminescence area. because, window part 4a of an insulator layer 4 -- extending (it enlarging) -- it is because fixing of a toner will lap with the next dot and a quality of printed character will be spoiled, if the phenomenon separation of light becomes impossible between adjacent dots (window parts 4a and 4a) happens and such a phenomenon happens

[0034] In the organic EL array 20 of this example of an operation gestalt, without extending window part 4a of an insulator layer 4 by having formed crevice 21a in the electron-injection electrode 21, as mentioned above, it has structure which enlarged luminescence area, therefore can avoid un-arranging [that the aforementioned quality of printed character is spoiled]. The result which asked below for the ability of the organic EL array 20 of this example of an operation gestalt to shorten [how much luminescence time] by calculation is shown.

[0035] Total amount Pt of one luminescence dot (organic [EL]), i.e., the outgoing radiation light around unit time from one window part 4a, It is proportional to the luminescence area A. It is as follows when this is expressed with a formula.

Pt =axA -- (1)

Here, a is the total amount of unit time and the outgoing radiation light per unit area, and is decided by the property organic [EL].

[0036] By the way, in the light source in the optical printer of an electrophotography method especially an LED array, or organic EL array of this invention, if the density of a luminescence dot is decided, the size of these luminescence dot and area will be decided almost automatically. It is because the phenomenon exposed to the next dot occurs if too small and it is [the amount of light itself decreases and] too large. Then, the area of the luminescence dot formed with the optimal size is fixed as S. This S corresponds to the area of window part 4a of an insulator layer 4 in this example of an operation form. And it is Ps about the total amount of the outgoing radiation light around [which can be taken out from this S] unit time. If it carries out, since luminescence area can be increased in fixed S in this example of an operation form, if the increment of the luminescence area by formation of crevice 21a is set to alpha, it is Ps about the total amount of outgoing radiation light. It can express as follows.

Ps =ax (S+alpha) -- (2)

[0037] Total amount Ps of the outgoing radiation light around [which is emitted from window part 4a of an insulator layer 4] unit time Inside, The total amount around [which the convergence nature rod-lens array 12 shown in drawing 2 is penetrated, and is further irradiated by the photoconductor drum 13] photometric-units time (luminescence power is called hereafter.) PD When efficiency in consideration of the probability which can carry out incidence

to the convergence nature rod-lens array 12, the probability which can penetrate the convergence nature rod-lens array 12 is set to eta, it can express with the following formulas.
PD =Ps xeta -- (3)
Furthermore, it is as follows if a formula (2) is substituted for a formula (3).
PD =ax(S+alpha) xeta -- (4)
[0038] Next, when luminescence time is set to T, the total amount E of the light which contributes to exposure, i.e., exposure energy, can be expressed with the following formulas.
E=PD xT -- (5)
It is as follows if a formula (3) is substituted for a formula (5).
E=Ps x etaxT -- (6)
It is as follows if a formula (2) is substituted for a formula (6).
E=ax(S+alpha) x etaxT -- (7)
If this is expressed about T, it will become the following.
T=E/[axetax (S+alpha)] -- (8)
Moreover, since the total amount E of the light which contributes to exposure, i.e., exposure energy, is fixed, it is as follows.
T=K/(S+alpha) -- (9)
Here, K=E/[axeta is a constant.
[0039] Next, luminescence time explains concretely which was shortened by this example of an operation gestalt using a numeric value. A length of one sides of P [in / S=15micrometerx15micrometer=225micrometer2 and drawing 3 (b) / for the area (S) of window part 4a of an insulator layer 4] and Q was set to 5 micrometers and 10 micrometers. Therefore, the area (alpha) which increased by crevice 21a is set to alpha=1micrometer(level difference) x10micrometer(one-side length) x4(number of neighboring)+1micrometer(level difference) x5micrometer(one-side length) x4(number of neighboring) =60micrometer2.
[0040] Therefore, it is set to (S+alpha) / S= 1.27, and luminescence area becomes the increase of 27%. In addition, according to survey, it is the actual luminescence power PD. It was increasing about 50%. That is, it is actual PD although only an area increment increases due to a formula (4). It becomes large more than it is expressed with a formula (4). For the luminescence time T, this is not the formula (9) showing only the area effect but the actual luminescence power PD. It is thought that it is because a formula (5) is followed since it is determined.
[0041] Thus, if it was in the organic EL array 20 of this example of an operation gestalt, since crevice 21a was formed in the electron-injection electrode 3, compared with the case where this is not formed, luminescence power can be increased 1.5 times, and, thereby, luminescence time can be shortened to 3 by about 2/. and luminescence time -- about -- it can be made two thirds -- time required for printing per line -- about -- the printing speed which it can be shortened to two thirds, therefore can be printed to around unit time can be increased about 1.5 times That is, in this example of an operation gestalt, printing speed can be directly made quick only by configuration processing of the electron-injection electrode 3. In addition, in this invention, if it is the configuration to which the thickness of the electron-injection electrode 3 becomes thin gradually the shape of the said heart toward the center of window part 4a of an insulator layer 4, without being limited to the configuration shown in drawing 3 (a) and (b) about the configuration of a crevice, of course, the configuration which has three or more steps of level differences, for example, the configuration gradually dented in the shape of a taper are sufficient.
[0042] Drawing 4 (a) and (b) are drawings showing the 3rd example of an operation gestalt of this invention, and a sign 30 is organic EL array in these drawings. The place where this organic EL array 30 differs from the organic EL array 1 shown in drawing 1 (a) and (b) is the point that four thin part 31a with thin thickness is formed in the electron-injection electrode 31 compared with other parts. That is, four thin part 31a is formed in the portion located in window part 4a of an insulator layer 4 at the electron-injection electrode 31 of the organic EL array 30 in this

example of an operation gestalt. Thin part 31a is a plane view square-like thing, and as shown in drawing 4 (a), it is equally arranged from the center of this window part 4a at the four-corners section of window part 4a. Here, the reason which has arranged four thin part 31a equally from a center in this way is for making it a direction dependency not appear in the outgoing radiation intensity of light like the case of the 2nd example of an operation gestalt.

[0043] As for thin part 31a, the thickness is set to 100nm in the electron-injection electrode 3, and the level difference with other parts of the electron-injection electrode 3 is set to 1 micrometer. Namely, as for the electron-injection electrode 3, the thickness of parts other than thin part 31a is formed in 1.1 micrometers. In addition, since it is easily processible conventionally also about such thin part 31a with a phot well-known lithography technology and etching technology, the explanation is omitted.

[0044] Moreover, after forming the electron-injection electrode 21 naturally and forming crevic 21a by ETCHIGGU further in manufacture of the organic EL array 20 with such an electron-injection electrode 21, formation of an insulator layer 4 and processing of the window part 4a are performed. And although a luminous layer 5, the electron hole transporting bed 6, and a transparent electrode 7 are formed one by one on it, since window part 4a of an insulator layer 4 is formed so that the aforementioned crevice 21a may be located in the interior, this crevice 21a will be exposed outside (upper surface side) within window part 4a. Therefore, a luminous layer 5 is seen also in this, as by being formed in contact with this crevice 21a showed to drawing 3 (b), and the upper crevice is formed. Furthermore, an apparent crevice is similarly formed in the electron hole transporting bed 6 and a transparent electrode 7.

[0045] Moreover, like the example of an operation form of the above 2nd, by forming thin part 31a-- in the electron-injection electrode 21 in this way, the rest is seen also in a luminous layer 5, the electron hole diffusion layer 6, and a transparent electrode 7, and can form the upper crevice by the usual manufacture method. Therefore, even if it is in this 3rd example of an operation form, compared with the thing of the 1st example of an operation form, the surface area itself is large, from a bird clapper, the luminescence area also becomes large and, naturally, thereby, the luminous layer 5 especially formed in window part 4a of an insulator layer 4 can increase the total amount of the outgoing radiation light around unit time. And even if it is in this 2nd example of operation form organic EL array 30 by the ability increasing the total amount of outgoing radiation light in this way, as mentioned above, the total amount of the light which condenses to a photoconductor drum 13 through the convergence nature rod-lens array 12 in the composition of drawing 2 can be increased, and the total amount of the light around [which is condensed by the photoconductor drum 13 by this] unit time can be increased.

[0046] The result which asked below for the ability of the organic EL array 30 of this example of an operation form to shorten [how much luminescence time] concretely by calculation using the numeric value like the case of the 2nd example of an operation form is shown. A length [in / the plane view configuration of S=15micrometerx15micrometer=225micrometer2 and thin part 31a / for the area (S) of window part 4a of an insulator layer 4] of one side was set to 5 micrometers. Therefore, area which increased by four thin part 31a (alpha)
alpha=1micrometer(level difference) x5micrometer(one-side length) x4(number of neighboring) x4 (the number of thin parts)
= 80micrometer2 It becomes. Therefore, it is set to (S+alpha) / S= 1.36, and luminescence area becomes the increase of 36%. In addition, according to survey, it is the actual luminescence power PD. It was increasing about 70%. This is considered because the same effect as the case of the 2nd example of an operation form has occurred.

[0047] Thus, if it was in the organic EL array 30 of this example of an operation form, since thin part 31a-- was formed in the electron-injection electrode 3, compared with the case where this is not formed, luminescence power can be increased 1.7 times, and, thereby, luminescence time can be shortened to 5 by about 3/. and luminescence time -- about -- it can be made three fifths -- time required for printing per line -- about -- the printing speed which it can be

shortened to three fifths, therefor can be printed to around unit time can be increased about 1.7 times That is, in this example of an operation form, only by configuration processing of the electron-injection electrode 3, since printing speed can be directly made quick and four thin part 31a-- can moreover be once formed at an etching process, a process can be simplified and, thereby, low-cost-ization can also be attained. in addition, without it being alike and being limited to four about the number of thin part 31a, it is plurality, and if a manufacture top is possible, it is good in this invention, without limit

[0048] Drawing 5 (a) and (b) are drawings showing the 4th example of an operation form of this invention, and a sign 40 is organic EL array in these drawings. The place where this organic EL array 40 differs from the organic EL array 1 shown in drawing 1 (a) and (b) is the point that the 2nd insulator layer 41 is formed between a substrate 2 and the electron-injection electrode 3, and crevice 41a to which the thickness becomes thin stair-like gradually toward the center of window part 4a of an insulator layer 4 at this 2nd insulator layer 41 is prepared.

[0049] That is, formation of the electron-injection electrode 3 is preceded in the organic EL array 40 in this example of an operation form, and it is SiNX on a substrate 2. A film and SiOX The 2nd insulator layer 41 which consists of a film is formed. Crevice 41a of the same configuration as crevice 21a formed in the electron-injection electrode 21 in the 2nd example of an operation form is formed in this 2nd insulator layer 41. That is, this crevice 41a was also taken toward the center of window part 4a of an insulator layer 4 like the aforementioned crevice 21a, the thickness of the 2nd insulator layer 41 was thinly formed of the bird clapper stair-like gradually, and a plane view square-like crevice is dented and formed in two stages, and the depression of these 2 stage is formed in the shape of the said heart to the center of window part 4a. And the electron-injection electrode 3 is the thing of a configuration in alignment with the configuration of this crevice 41a by being formed on the 2nd insulator layer 41 in which such crevice 41a was formed.

[0050] In addition, also in this crevice 41a, the field of the shape of drawing 5 (a) and a plane view square shown in [P] (b) serves as a portion which is a core and was formed most thinly, and the field of the shape of the field of the outside of this P field, i.e., drawing 5 , (a), and a plane view square frame shown in [Q] (b) serves as a portion formed thinly next. And in this example of an operation form, thickness of the field shown by P was set to 100nm like crevice 21a in the 2nd example of an operation form, and the level difference per step of the stairway in crevice 41a was set to 1 micrometer. Therefore, the thickness of the thickest portion of the 2nd insulator layer 41 is set to 2.1 micrometers, and the thickness of the field shown by Q is set to 1.1 micrometers. About the configuration of such stair-like crevice 41a, since it is easily processible conventionally with a phot well-known lithography technology and etching technology, the explanation is omitted. Moreover, the reason which can dent crevice 41a in the shape of the said heart is for making it a direction dependency not appear in the outgoing radiation intensity of light like the 2nd example of an operation form.

[0051] As mentioned above, after forming the 2nd insulator layer 41 and forming crevice 41a by ETCHIGGU further in manufacture of the organic EL array 40 with such 2nd insulator layer 41, formation of the electron-injection electrode 3, formation of an insulator layer 4, and processing of the window part 4a are performed. At this time, as by being formed in contact with this crevice 41a showed the electron-injection electrode 3 to drawing 5 (b), a stair-like crevice is seemingly formed also in this. Subsequently, although a luminous layer 5, the electron hole transporting bed 6, and a transparent electrode 7 are formed one by one on an insulator layer 4, since window part 4a of an insulator layer 4 is formed so that the aforementioned crevice 41a may be located in the interior, the apparent crevice of the electron-injection electrode 3 formed on this crevice 41a will be exposed outside (upper surface side) within window part 4a. Therefore, a respectively apparent stair-like crevice is formed also in a luminous layer 5, the electron hole transporting bed 6, and a transparent electrode 7.

[0052] Thus, by forming crevice 41a in the 2nd insulator layer 41, by the usual manufacture

method, the rest is seen also in the electron-injection electrode 3, a luminous layer 5, the electron hole diffusion layer 6, and a transparent electrode 7, and can form the upper crevice. Therefore, compared with the thing of the 1st example of an operation gestalt, the surface ar a itself becomes large by the stair-like configuration and bird clapper corresponding to the configuration of crevice 41a in the luminous layer 5 especially formed in window part 4a of an insulator layer 4. Therefore, even if it is in the thing of this example of an operation gestalt, greatly, from the bird clapper, the luminescence area can increase the total amount of the outgoing radiation light around unit time, and, naturally can increase the total amount of the light around [which is condensed by the photoconductor drum 13 in the composition which this showed to drawing 2] unit time.

[0053] In addition, it is easy to crystallize a luminous layer 5 and the electron hole transporting bed 6 in a portion with a level difference, and once it crystallizes these, the crystalline region will spread. And if this trespasses even upon a luminescence field, the portion will become the dark spot which does not emit light, will become what forms a point defect, and will spoil a quality of printed character remarkably. Therefore, as for an unnecessary level difference configuration, not giving as much as possible is desirable. In this example of an operation gestalt, since the shape of toothing is formed only in the window part 4 of an insulator layer with the need of enlarging luminescence area, formation of the point defect accompanying crystallization of a luminous layer 5 or the electron hole transporting bed 6 can be suppressed to the minimum, and improvement in the yield can be aimed at.

[0054] The result which asked below for the ability of the organic EL array 40 of this example of an operation gestalt to shorten [how much luminescence time] concretely by calculation using the numeric value like the case of the 2nd example of an operation gestalt is shown. A length of one sides of P [area / (S) / of window part 4a of an insulator layer 4] in S= 15 micrometerx15-micrometer=225-micrometer 2 and drawing 5 (b) and Q was set to 5 micrometers and 10 micrometers. Therefore, the area (alpha) which increased by crevice 41a is set to alpha=1micrometer(level difference) x10micrometer(one-side length) x4(number of neighboring)+1micrometer(level difference) x5micrometer(one-side length) x4(number of neighboring) =60micrometer2. Therefore, it is set to (S+alpha) / S= 1.27, and luminescence area becomes the increase of 27%. In addition, according to survey, it is the actual luminescence power PD. It was increasing about 50%. This is considered because the same effect as the case of the 2nd example of an operation gestalt has occurred.

[0055] Thus, if it was in the organic EL array 40 of this example of an operation gestalt, since crevice 41a was formed in the 2nd insulator layer 41, compared with the case where this is not formed, luminescence power can be increased 1.5 times, and, thereby, luminescence time can be shortened to 3 by about 2/. and luminescence time -- about -- it can be made two thirds -- time required for printing per line -- about -- the printing speed which it can be shortened to two thirds, therefore can be printed to around unit time can be increased about 1.5 times That is, in this example of an operation gestalt, printing speed can be directly made quick only by configuration processing of the electron-injection electrode 3. In addition, in this invention, if it is the configuration to which the thickness of the 2nd insulator layer 4 becomes thin gradually the shape of the said heart toward the center of window part 4a of an insulator layer 4, without being limited to the configuration shown in drawing 5 (a) and (b) about the configuration of a crevice, of course, the configuration which has three or more steps of level differences, for example, the configuration gradually dented in the shape of a taper are sufficient.

[0056] Drawing 6 (a) and (b) are drawings showing the 5th example of an operation gestalt of this invention, and a sign 50 is organic EL array in these drawings. The place where this organic EL array 50 differs from the organic EL array 1 shown in drawing 1 (a) and (b) the side of the insulator layer 4 which forms each electron-injection electrode 3 and this window part 4a is worn into the portion located in window part 4a of an insulator layer 4, and the 2nd electron-injection electrode 51 prepares in it -- having -- a luminous layer 5 -- this -- it is the

point which covers the 2nd electron-injection electrode 51 and is formed

[0057] Namely, it sets to the organic EL array 50 in this example of an operation g stalt. After forming electron-injection electrode 3 and forming an insulator layer 4 and its window part 4a further, in contact with the side of the insulator layer 4 which covers this in contact with the electron-injection electrode 3, and forms window part 4a, the insulator layer 4 for a periphery of this window part 4a is also covered for this with a wrap, and the 2nd electron-injection electrode 51 is formed. As this 2nd electron-injection electrode 51, the low thing of a work function is desirable, it is specifically made suitable [a MgAg alloy, In, a MgIn alloy, a MgCu alloy, a MgLi alloy, etc.] so that easily [the electron injection to a luminous layer 5], in this example, a MgAg alloy is used and this is formed in 100nm in thickness. However, in this example of an operation gestalt, since it stops being almost related to the electron injection to a luminous layer 5 about the electron-injection electrode 3, a work function does not need to consider as a low thing, therefore aluminum is used.

[0058] If it is in the organic EL array 50 of this example of an operation gestalt Since the side of the insulator layer 4 which forms each electron-injection electrode 3 and this window part 4a for the 2nd electron-injection electrode 51 was worn and formed Also in the window part 4a side of the insulator layer 4 which causes optical leakage in window part 4a especially, by covering this by the 2nd electron-injection electrode 51, it reflects without the generated light leaking on this side, and is taken out as an outgoing radiation light. Consequently, total amount PS of outgoing radiation light It can enlarge.

[0059] The result which asked below for the ability of the organic EL array 50 of this example of an operation form to shorten [how much luminescence time] concretely by calculation using the numeric value like the case of the 2nd example of an operation form is shown. The amount of the light which it is newly reflected by the 2nd electron-injection electrode 51, and can be taken out outside as an outgoing radiation light is equivalent to the following reflector product increase parts beta.

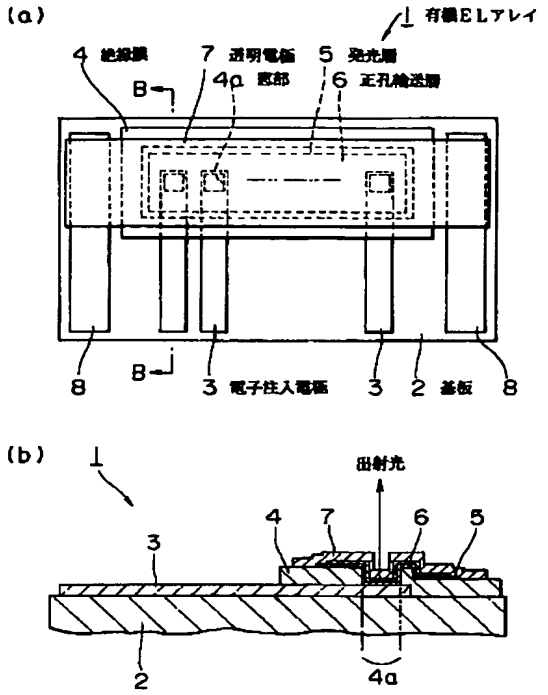
a part for reflector product increase -- beta=0.3micrometer(thickness of insulator layer) x15micrometer(one-side length of window part) x4(number of neighboring) =18micrometer2 -- here, PD2 is as follows when luminescence power obtained when only beta increases a reflector product is set to PD2

Although PD2=PD / (S+beta) S=1.08P luminescence area does not change, a reflector product becomes the increase of 8%. In addition, according to survey, the actual luminescence power PD 2 was increasing about 20%. here -- it should observe -- it is the point which has not changed luminescence area If luminescence area becomes large, luminescence power will go up, and [instead] you also have to increase supply current. However, luminescence power can be raised in this example of an operation gestalt, without increasing supply current, since luminescence power can be raised without enlarging luminescence area.

[0060] Thus, if it was in the organic EL array 50 of this example of an operation gestalt, since the side of the insulator layer 4 which forms each electron-injection electrode 3 and this window part 4a for the 2nd electron-injection electrode 51 was worn and formed, compared with the case where this is not formed, luminescence power can be increased 1.2 times, and, thereby, luminescence time can be shortened to 5 by about 4/. and luminescence time -- about -- it can be made four fifths -- time required for printing per line -- about -- the printing speed which it can be shortened to four fifths, therefore can be printed to around unit time can be increased about 1.2 times Moreover, since luminescence power can be raised in this example of an operation gestalt, without increasing supply current, luminous efficiency can be improved and, thereby, reduction-ization of the consumed electric current can be attained.

[Translation done.]

Drawing selection [R presentative drawing]



第１の実施形態例の概略構成図

[Translation done.]

JAPANESE [JP,10-055890,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

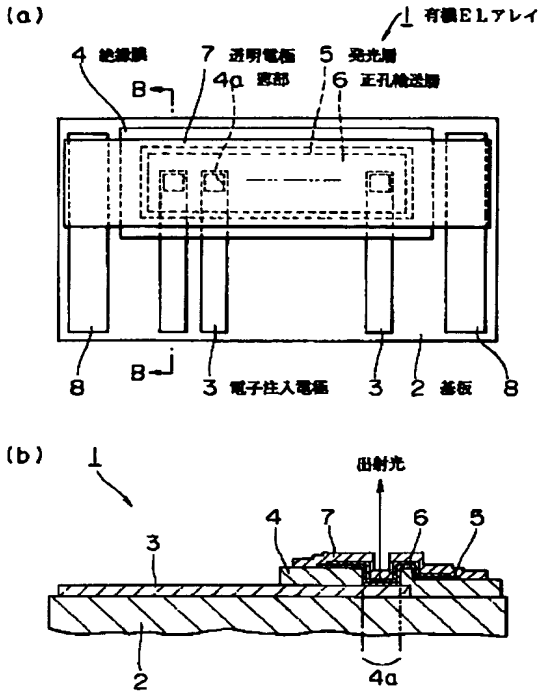
* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] (a) and (b) are drawings showing the outline composition of the 1st example of an operation gestalt of organic EL array in this invention, (a) is a plan and (b) is the B-B line view cross section of (a).
[Drawing 2] It is the outline block diagram of the print head using organic EL array shown in drawing 1 .
[Drawing 3] (a) and (b) are drawings showing the outline composition of the 2nd example of an operation gestalt of organic EL array in this invention, (a) is a plan and (b) is the B-B line view cross section of (a).
[Drawing 4] (a) and (b) are drawings showing the outline composition of the 3rd example of an operation gestalt of organic EL array in this invention, (a) is a plan and (b) is the B-B line view cross section of (a).
[Drawing 5] (a), (b), and (c) are drawings showing the outline composition of the 4th example of an operation form of organic EL array in this invention, and (a) is [the B-B line view cross section of (a) and (c of a plan and (b))] the C-C line view cross sections of (a).
[Drawing 6] (a) and (b) are drawings showing the outline composition of the 5th example of an operation gestalt of organic EL array in this invention, (a) is a plan and (b) is the B-B line view cross section of (a).
[Description of Notations]
1, 20, 30, 40, 50 Organic EL array
2 Substrate
3, 21, 31 Electron-injection electrode
4 Insulator Layer
4a Window part
5 Luminous Layer
6 Electron Hole Transporting Bed
7 Transparent Electrode
21a Crevice
31a Thin part
41 2nd Insulator Layer
41a Crevice
51 2nd Electron-Injection Electrode

[Translation done.]

Drawing selection [Repr sentativ drawing]



第１の実施形態例の概略構成図

[Translation done.]

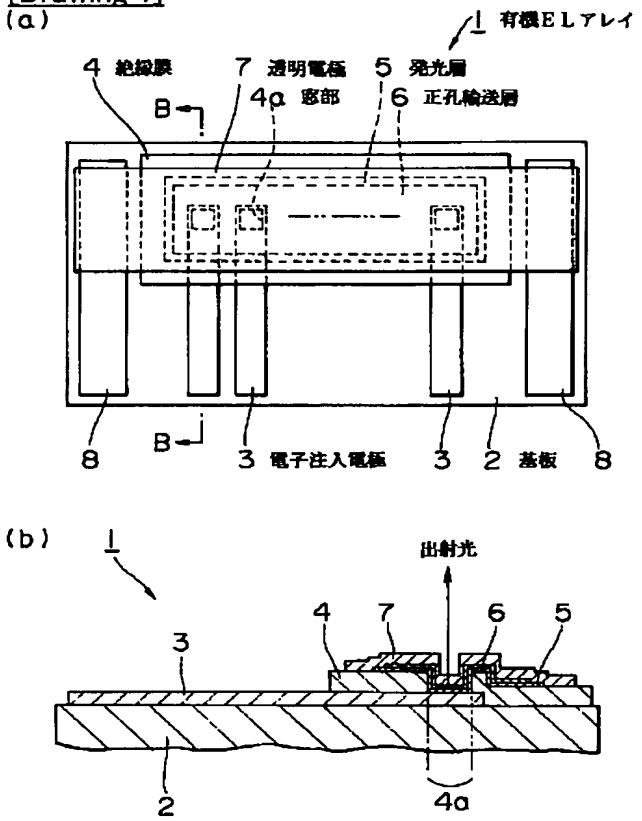
JAPANESE [JP,10-055890,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

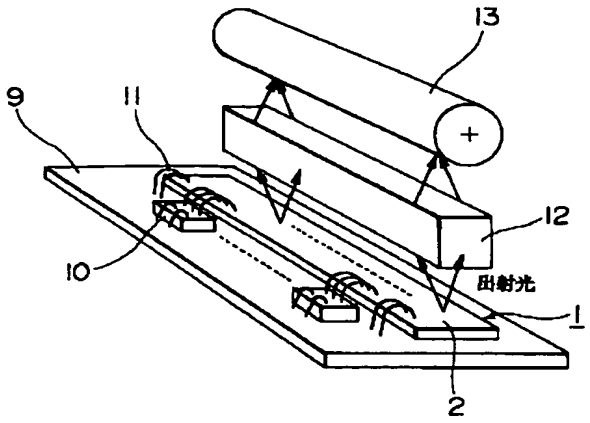
DRAWINGS

[Drawing 1]



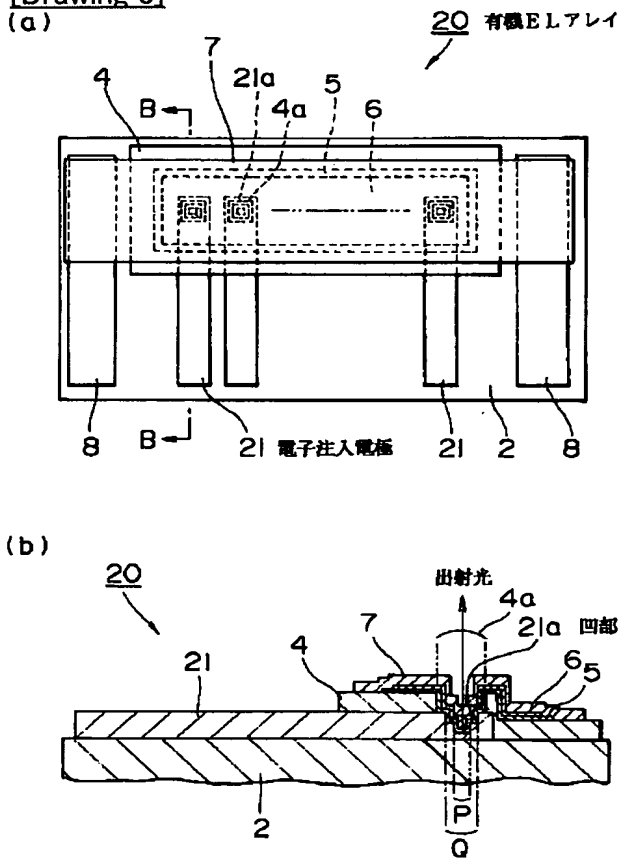
第１の実施形態例の概略構成図

[Drawing 2]



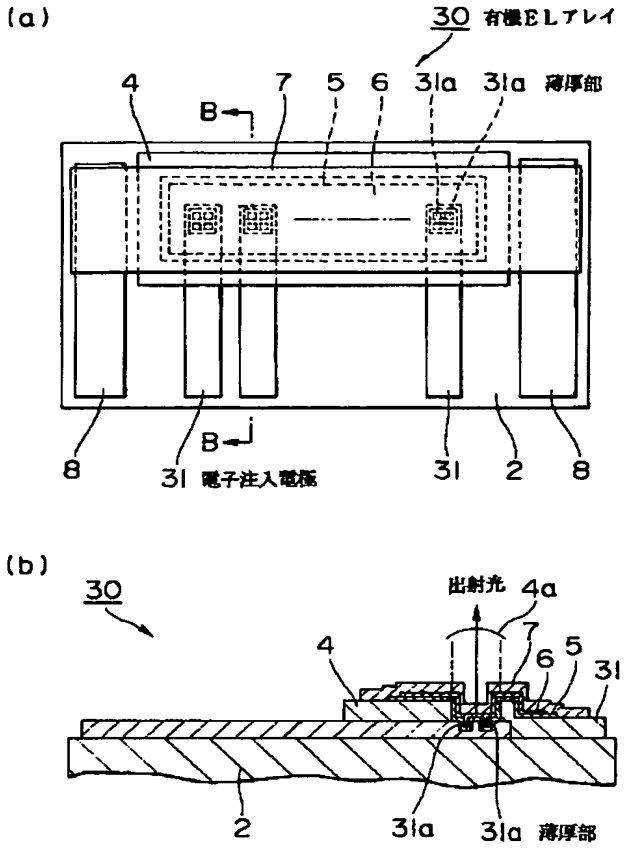
プリントヘッドの概略構成図

[Drawing 3]



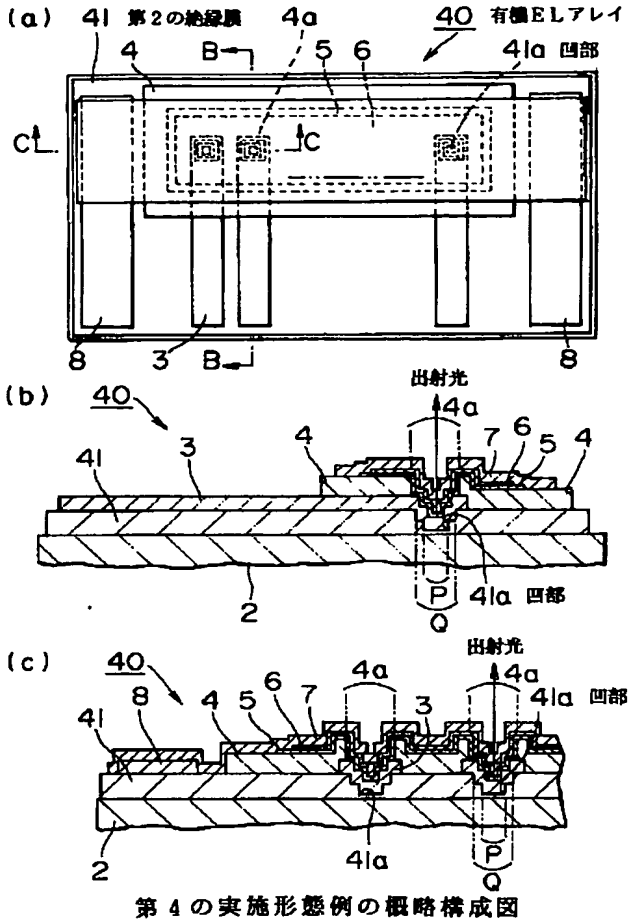
第２の実施形態例の概略構成図

[Drawing 4]



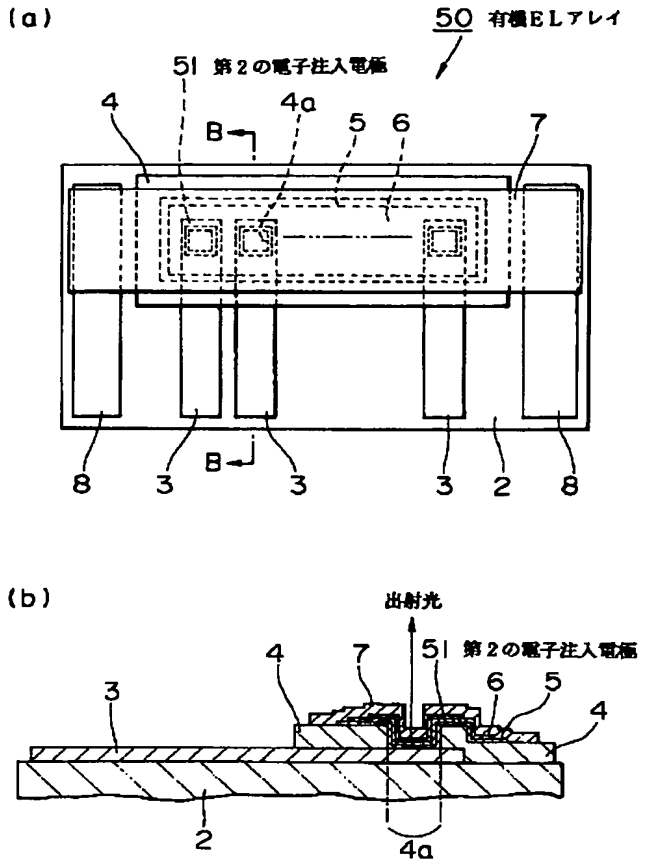
第 3 の実施形態例の概略構成図

[Drawing 5]



第 4 の実施形態例の概略構成図

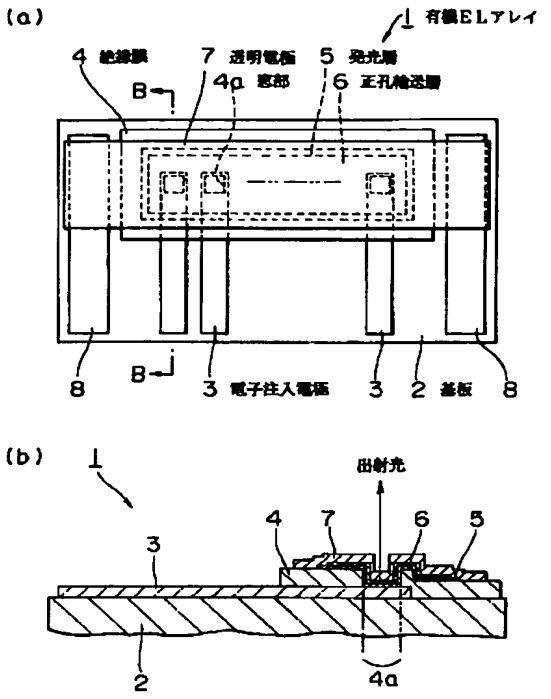
[Drawing 6]



第５の実施形態例の概略構成図

[Translation done.]

Drawing selection [R pr s ntative drawing]



第１の実施形態例の概略構成図

[Translation done.]

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2/45			Ｂ４１Ｊ　3/21	Ｌ	
2/455					
Ｈ０４Ｎ　1/036					

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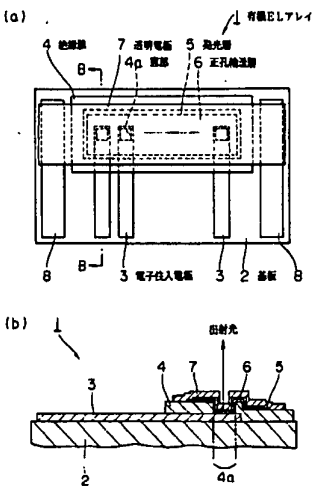
最終頁に続く

(54)【発明の名称】　有機ＥＬアレイ

(57)【要約】

【課題】　実装上の困難さを回避し、低コスト化や高密度化を図ることのできる有機ＥＬアレイの提供が望まれている。

【解決手段】　複数の発光ドットを有する有機ＥＬアレイ１である。絶縁性基板２と、これの上に形成された電子注入電極３と、電子注入電極３の一部を覆って絶縁性基板２上に形成され、かつ電子注入電極３の直上部で開口する発光ドットとなる窓部４ａを有した絶縁膜４と、窓部４ａを覆って窓部４ａ内から外に臨む電子注入電極３に接して形成された発光層５と、窓部４ａの直上位置を覆って発光層５上にこれと接して形成された正孔輸送層６と、正孔輸送層６と発光層５とを覆い、かつ正孔輸送層６に接して絶縁性基板２上に形成された透明電極７と、を備えてなる。



第１の実施形態例の概略構成図

１

【特許請求の範囲】

【請求項１】　複数の発光ドットを有する有機ＥＬアレイであって、

絶縁性基板と、

該絶縁性基板上に形成された前記発光ドット数と略同数の電子注入電極と、

これら電子注入電極のそれぞれの一部を覆って前記絶縁性基板上に形成され、かつ該電子注入電極のそれぞれの直上部にて開口する発光ドットとなる窓部を有した絶縁膜と、

前記窓部を覆って該窓部内から外に臨む電子注入電極のそれぞれに接して形成された発光層と、

前記窓部の直上位置を覆って前記発光層上にこれと接して形成された正孔輸送層と、

該正孔輸送層と前記発光層とを覆い、かつ該正孔輸送層に接して前記絶縁性基板上に形成された透明電極と、を備えたことを特徴とする有機ＥＬアレイ。

【請求項２】　請求項１記載の有機ＥＬアレイにおいて、

前記電子注入電極には、前記絶縁膜の窓部内に位置する部分に、その厚さが該窓部の中心に向かって同心状に徐々に薄くなる凹部が設けられていることを特徴とする有機ＥＬアレイ。

【請求項３】　請求項１記載の有機ＥＬアレイにおいて、

前記電子注入電極には、前記絶縁膜の窓部内に位置する部分に、他の箇所に比べて厚さの薄い薄厚部が複数形成されていることを特徴とする有機ＥＬアレイ。

【請求項４】　請求項１記載の有機ＥＬアレイにおいて、

前記絶縁性基板と電子注入電極との間には第２の絶縁膜が設けられ、

該第２の絶縁膜には、前記絶縁膜の窓部内に位置する部分に、その厚さが該窓部の中心に向かって同心状に徐々に薄くなる凹部が設けられ、

前記電子注入電極は、前記凹部上にて該凹部の形状に沿った形状となっていることを特徴とする有機ＥＬアレイ。

【請求項５】　請求項１記載の有機ＥＬアレイにおいて、

少なくとも前記絶縁膜の窓部内に位置する部分には、前記電子注入電極および該窓部を形成する絶縁膜の側面を覆って第２の電子注入電極が設けられ、

前記発光層は、前記第２の電子注入電極を覆って形成されたことを特徴とする有機ＥＬアレイ。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は、電子写真式プリンタにおける光プリンタヘッドに好適に用いられる有機ＥＬ（electroluminescence）アレイに関する。

２

【０００２】

【従来の技術】電子写真プリンタの光源としては、従来、例えば「電子写真学会誌　第２４巻第２号（１９８５）第３１頁～第３６頁；ＬＥＤプリンタ（鈴木怡、高須広海、深津猛夫）」に開示されているようなＬＥＤアレイプリンタヘッドが知られている。このようなＬＥＤアレイプリンタヘッドを備えたＬＥＤプリンタは、光源であるＬＥＤアレイがヘッドとしてソリッドステート化されており、またレーザプリンタのような機械的駆動部がないため高い信頼性が得られ、さらに光路長が短いため小型化が可能である。また、ＬＥＤアレイは、量産実績のある半導体製造技術で生産されているため、量産化による低コスト化を期待することができる。

【０００３】前記文献において開示されたＬＥＤプリンタでは、その印字プロセスは以下のような順序で進められる。まず、感光ドラムに帯電器を用いて一様な電荷を与える。次に、感光ドラム面にＬＥＤアレイからの光を集束性ロッドレンズアレイを介して結像させ、潜像を形成する。次いで、現像機により可視像とした、その後記録紙に転写、定着させる。さらに、残留トナーのクリーニング、残留電位の除電を行い印字プロセスを終了する。なお、感光ドラムについても、ＬＥＤの発光波長に合った感度特性をもつものが開発されている。

【０００４】また、このＬＥＤプリンタにおいてＬＥＤアレイを備えたＬＥＤアレイプリンタヘッドは、アルミナのセラミック基板に厚膜パターンを形成した基板を有し、この基板の中央部にＬＥＤチップを一直線上に並べ、その両側にＩＣチップを導電性ペーストにてダイボンドし、ワイヤボンドによって電気的接続を行ったものである。信号および電源は、ＦＰＣ（フレキシブルプリント板）基板を介してセラミック基板に供給されるようになっている。また、ＬＥＤチップを選択的に接続できるかどうかは、チップの切断精度によって決まるようになっている。

【０００５】ところで、ＬＥＤの材料には三つの特性が要求されている。

ａ）光のアイソレーションができること、

ｂ）高密度化が可能な拡散プロセスを使えること、

ｃ）経済的価格で安定した特性が得られること、

の三つであり、このような要求を満たすものとしては、現在、ＧａＡｓ基板上に気相成長したＧａＡｓＰが最適であるとされている。

【０００６】このようなＬＥＤを製造するには、ｎ型ＧａＡｓＰウエハにＣＶＤ法等によって拡散防止膜を形成し、これにホトリソグラフィー法によって発光窓を開ける。次に、ウエハおよびＰ型不純物を石英アンプルに真空封入し、約７００℃の温度で数時間拡散を行い、発光窓にＰＮ接合を形成する。このとき、拡散深さとしては５～７μｍが適当である。

【０００７】次いで、Ｐ側にＡｌ、Ｎ側にＡｕ合金をそ

れぞれ蒸着してオーミック電極を形成する。発光部寸法は密度（解像度）によっておおむね決まり、１６ドット／ｍｍ（ピッチ６２．５μｍ）では４０μｍになる。１チップ当たりのドット数はチップ歩留りと寸法により６４ドットまたは１２８ドットが実用的である。発光波長は材料で決まり、この例では６６０ｎｍとされている。

【０００８】１チップ内の光量バラツキは現状では±１０％のレベルから±４０％までが１ウエハ内に含まれており、プローバ検査により選別され、±２０％以下のものが使用されている。ＬＥＤチップの切断精度は配列精度に影響し、±５μｍ以内の高精度な切断技術が必要とされる。この接続部分の切断については、へき開を利用したスクライブ法が用いられている。

【０００９】

【発明が解決しようとする課題】しかしながら、前述のＬＥＤアレイプリントヘッドでは、そのＬＥＤアレイについて以下に述べる不都合がある。ウエハに内在する欠陥や、製造工程の不均一性などに起因する素子間の性能のばらつきが不可避である。また、ＬＥＤアレイの基板となるＧａＡｓなどの基板は、現在のところせいぜい３インチ程度の大きさのものしか作製することができず、しかも高価である。さらに、結晶の欠陥が多く、モノリシック型でドット数を多くすると歩留りが悪くなってしまう。

【００１０】そこで、少ないドット数のアレイチップを多数作り、これらを接続して全記録幅をカバーするようにしているが、その場合、チップ接続部に配列誤差が生じ、高密度になるにつれてこの配列誤差が大きくなることなどから、基板への実装が非常に困難になってしまう。このような実装上の困難さは、低コスト化や高密度化を損なう大きな要因となっている。本発明は前記事情に鑑みてなされたもので、その目的とするところは、実装上の困難さを回避し、低コスト化や高密度化を図ることのできる有機ＥＬアレイを提供することにある。

【００１１】

【課題を解決するための手段】本発明の有機ＥＬアレイでは、絶縁性基板と、該絶縁性基板上に形成された発光ドット数と略同数の電子注入電極と、これら電子注入電極のそれぞれの一部を覆って前記絶縁性基板上に形成され、かつ該電子注入電極のそれぞれの直上部にて開口する発光ドットとなる窓部を有した絶縁膜と、前記窓部を覆って該窓部内から外に臨む電子注入電極のそれぞれに接して形成された発光層と、前記窓部の直上位置を覆って前記発光層上にこれと接して形成された正孔輸送層と、該正孔輸送層と前記発光層とを覆い、かつ該正孔輸送層に接して前記絶縁性基板上に形成された透明電極と、を備えたことを前記課題の解決手段とした。

【００１２】この有機ＥＬアレイによれば、ガラスなどの細長く作ることが可能な絶縁性基板上に一括して作製されるので、従来のＬＥＤアレイのごとくＬＥＤチップを多数一直線上に配列させるといった実装上の困難さが避けられる。また、絶縁膜の窓部を形成した側、すなわち絶縁性基板の上面側から光を取り出す構造としたので、例えばガラスからなる基板の裏面から光を取り出す場合に起こる、ガラス裏面における全反射による光の損失や、ガラスへの吸収による光の損失をなくして光を効率良く外部に取り出すことが可能になる。

【００１３】

【発明の実施の形態】以下、本発明の有機ＥＬアレイをその実施形態例によって詳しく説明する。図１（ａ）、（ｂ）は本発明の第１の実施形態例を示す図であり、これらの図において符号１はプリントヘッドの光源となる有機ＥＬアレイである。この有機ＥＬアレイ１は、多数の発光ドット数を有するもので、ガラスからなる絶縁性で矩形板状の基板２上に複数の電子注入電極３…と、絶縁膜４と、発光層５と、正孔輸送層６と、透明電極７とを備えて形成されたものである。

【００１４】電子注入電極３…は、図１（ａ）に示すように平面視矩形状のもので、発光ドット数に対応した数の分基板２上に形成されたものであり、それぞれ所定間隔をおいて基板２の短辺方向に向いた状態に並列させられたものである。これら電子注入電極３…としては、発光層５への電子注入が容易なように仕事関数が低いものが好ましく、具体的にはＭｇＡｇ合金、Ｉｎ、ＭｇＩｎ合金、ＭｇＣｕ合金、ＭｇＬｉ合金などが好適とされ、本例ではＭｇＡｇ合金が用いられてこれが厚さ２００ｎｍに形成されている。

【００１５】また、前記基板２上には、前記電子注入電極３…のそれぞれの一部を覆って絶縁膜４が形成されている。この絶縁膜４には、前記電子注入電極３…のそれぞれの直上部にて平面視正方形状に開口する窓部４ａが形成されている。窓部４ａは、発光ドットとなるものであり、この窓部４ａが各電子注入電極３毎に形成されることにより、有機ＥＬアレイは多数の発光ドットを有したものとなる。なお、この絶縁膜４が必要な理由は以下の通りである。

【００１６】後述するように発光層５と正孔輸送層６とは有機膜であることからホトリソグラフィー法を用いたパターニングの工程に耐えられず、したがってこのパターニングが行えないものとなっている。しかして、電子注入電極３と絶縁膜４の上に形成される発光層５とが接する領域は、発光が起きる領域を規定するうえでその面積を正確に形成しなければならない。そこで、電子注入電極３を形成した後に該電子注入電極３と後に形成する発光層５との間に正確なパターニングが可能な絶縁膜４を形成してこれを介在させ、かつ電子注入電極３と発光層５とを絶縁膜４に形成した窓部４ａを介して接合させることにより、該絶縁膜４の窓部４ａのパターニングを正確に行うことによって電子注入電極３と発光層５とが接する領域、すなわち発光が起きる領域の面積を正確に

規定することができるのである。このような理由により、絶縁膜４としてはホトリソグラフィー法によるファインパターン化が図れる材料から形成するのが好ましく、この例では、SiN_x 膜やSiO_x 膜などが用いられてこれが厚さ３００ｎｍに形成されている。

【００１７】また、この絶縁膜４の上には、その窓部４ａを覆って発光層５が形成されている。この発光層５は、前述したように絶縁体４の窓部４ａ内から外に臨む電子注入電極３…のそれぞれに接して形成されたもので、有機膜からなるものである。この発光層５としては、電子が注入され易いようにその電子親和力が２．５ｅＶ以上であることが望ましく、具体的には金属キレート化合物、多環縮合または共役芳香族炭化水素、ベンズオキサゾールまたはベンゾチアゾール誘導体、ペリレン系化合物、クマリン系化合物などが好適とされ、また、発光の波長制御や高効率化のため、ピラン誘導体、クマリン誘導体、シアニン誘導体、キナクリドン誘導体などの蛍光性色素をドーピングするのも有効である。また、後述する正孔輸送層６から発光層５への正孔注入が容易になるように、発光層５はそのイオン化ポテンシャルが正孔輸送層６のそれより低くなければならない。そして、このような条件を踏まえて本例では、発光層５として８－キノリノールアルミニウム錯体（Alq_3）を用い、これを抵抗加熱による真空蒸着によって厚さ５０ｎｍに形成している。なお、この真空蒸着としては、形成したい領域だけ蒸着させるマスク蒸着を採用した。

【００１８】この発光層５上には、絶縁膜４の窓部４ａの直上位置を覆って正孔輸送層６が形成されている。この正孔輸送層６としては、イオン化ポテンシャルが低い電子供与性の分子、または置換基を有したもので、発光波長に対して透明である必要があり、具体的にはトリフェニルアミン誘導体で、ベンジジン型、スチリルアミン型、ジアミン型などが好適とされる。そして、この例ではジアミン誘導体（ＴＰＤ）が用いられ、前記発光層５と同様に抵抗加熱による真空蒸着によって厚さ５０ｎｍに形成されている。

【００１９】また、前記基板２上には、正孔輸送層６と発光層５とを覆い、かつ正孔輸送層５に接して透明電極７が形成されている。この透明電極７は、透光性、すなわち発光波長に対して透過性を有するものからなるもので、かつ、後述するように有機膜である正孔輸送層６への正孔の注入を容易にするため、仕事関数が大きい導体であることが好ましく、この例では、インジウムースズ酸化物（ＩＴＯ）によって厚さ１５０ｎｍに形成されている。また、この透明電極７が正孔輸送層６および発光層５を覆って形成されるのは、正孔輸送層６および発光層５が有機膜であることから、これら有機膜の空気接触による劣化を防ぐためである。

【００２０】この透明電極７は、図１（ａ）に示すように基板２の両側に配置された共通電極８と電気的に接続されている。この共通電極８は、電子注入電極３と同時に形成されたものである。そして、このような構成のもとに有機ＥＬアレイ１は、絶縁膜４の窓部４ａの部分にて各々の電子注入電極３と透明電極７との間に発光層５と正孔輸送層６とを挟んだものとなっている。

【００２１】次に、このような構成の有機ＥＬアレイ１をプリントヘッドに適用した場合の例について図２を参照して説明する。図２において符号１は図１（ａ）、（ｂ）に示した有機ＥＬアレイであり、この有機ＥＬアレイ１の基板２はドライバーＩＣ１０とともに駆動回路基板９上に実装されている。駆動回路基板９とドライバーＩＣ１０とは、ボンディングワイヤ１１によって電気的接続がなされている。同様に、ドライバーＩＣ１０と有機ＥＬアレイ１の基板２、および有機ＥＬアレイ１の基板２と駆動回路基板９とについても、それぞれボンディングワイヤ１１によって電気的接続がなされている。

【００２２】有機ＥＬアレイ１の上方、すなわち有機ＥＬアレイ１の基板２の上面側には、集束性ロッドレンズアレイ１２；感光ドラム１３がこの順に配設されている。そして、このような構成のもとに、有機ＥＬアレイ１から発した光は基板２の上面側に出射し、集束性ロッドレンズアレイ１２を通って感光ドラム１３に集光されるようになっている。

【００２３】次に、図２に示したプリントヘッドの構成に基づき、図１（ａ）、（ｂ）に示した有機ＥＬアレイ１の動作を説明する。まず、図２において、印字したい内容のデータを駆動回路基板９上のドライバーＩＣ１０に送る。すると、図１（ａ）、（ｂ）に示した有機ＥＬアレイ１では、データが「ＯＮ」のドット（窓部４ａ）にはその電子注入電極３に共通電極８からみて負電位となるように電圧が印加される。ここで、「ＯＮ」か「ＯＦＦ」かは、予め設定された電子注入電極３への印加電圧の、２つのレベルの切り換えによる、電子注入電極３と共通電極８との間の電圧差の発生の有無によって決まる。

【００２４】「ＯＮ」の場合には以下のように動作する。供給電流は共通電極８にボンディングワイヤ１１を通して供給され、さらに透明電極７へと流れる。その結果、正孔輸送層６内への正孔注入が起こる。一方、電子注入電極３からは、同様にして発光層５への電子注入が起こる。発光層５に注入された電子は、発光層５の中を正孔輸送層６へと向かって移動していき、正孔輸送層６との境界面に達すると、発光層５と正孔輸送層６との電子親和力の差によってその移動がブロックされる。

【００２５】しかし、正孔輸送層６に注入された正孔は、正孔輸送層６の中を発光層５へと向かって移動していき、発光層５との境界面に達すると、この発光層５内に容易に注入され、そこで待機していた電子と再結合する。そして、この再結合エネルギーが発光層８を形成する８－キノリノールアルミニウム錯体（Alq_3）の励

起を引き起こし、さらに、この励起状態から基底状態に戻るとき、５４０ｎｍの発光波長の蛍光を発するのである。

【００２６】このようなメカニズムによって発生した光のうち、透明電極７側への光はそのまま透明電極７を透過し、一方、電子注入電極３側への光は該電子注入電極３によって反射され、両者ともに基板の上面から外部に取り出される。そして、この外部に取り出された光が、図２に示したように集束性ロッドレンズアレイ１２を通って感光ドラム１３に集光し、必要時間照射するものとなる。ここから先は、通常の電子写真方式プリンタと同様に動作する。なお、データが「ＯＦＦ」のドット（窓部４ａ）では、透明電極７と電子注入電極３との間に電位差がないので、電流が流れず、これによりこのドットでは発光が起こらない。

【００２７】したがって、このような有機ＥＬアレイ１にあっては、一枚の基板２上に一括して作製することができるので、従来のＬＥＤアレイのごとくＬＥＤチップを多数一直線上に配列させるといった実装上の困難さを避けることができ、低コスト化を図ることができる。また、基板２の上面側から光を取り出す構造としたので、例えばガラスからなる基板の裏面から光を取り出す場合に起こる、ガラス裏面における全反射による光の損失や、ガラスへの吸収による光の損失をなくして光を効率良く外部に取り出すことができ、これにより短時間で強い光を取り出せることからプリンタによる印字の高速化を可能にすることができる。

【００２８】図３（ａ）、（ｂ）は、本発明の第２の実施形態例を示す図であり、これらの図において符号２０は有機ＥＬアレイである。この有機ＥＬアレイ２０が図１（ａ）、（ｂ）に示した有機ＥＬアレイ１と異なるところは、電子注入電極２１に、その厚さが絶縁膜４の窓部４ａの中心に向かって同心状に徐々に薄くなる凹部２１ａが設けられている点である。

【００２９】すなわち、本実施形態例における有機ＥＬアレイ２０の電子注入電極２１には、絶縁膜４の窓部４ａ内に位置する部分に階段状の凹部２１ａが形成されている。この凹部２１ａは、絶縁膜４の窓部４ａの中心に向かうに連れ、電子注入電極２１の厚さが階段状に徐々に薄くなることによって形成されたもので、この例では平面視正方形状の凹部が二段階に凹んで形成され、かつこれら二段階の凹みが窓部４ａの中心に対して同心状に形成されたものである。ここで、凹部２１ａを同心状に凹ませる理由は、出射光の強さに方向依存性が出ないようにするためである。

【００３０】また、この凹部２１ａでは、図３（ａ）、（ｂ）中Ｐで示す平面視正方形状の領域が中心部であって最も薄く形成された部分となり、このＰ領域の外側の領域、すなわち図３（ａ）、（ｂ）中Ｑで示す平面視正方形枠状の領域が次に薄く形成された部分となっている。本実施形態例では、中心部の最も薄い部分であるＰで示す領域の膜厚を１００ｎｍとし、凹部２１ａ内における階段の一段あたりの段差を１μｍとした。よって、電子注入電極２１の最も厚い部分の膜厚は２．１μｍとなり、Ｑで示す領域の膜厚は１．１μｍとなる。なお、このような階段状の凹部２１ａの形状については、従来公知のホトリソグラフィ技術、およびエッチング技術によって容易に加工可能であるので、ここではその説明を省略する。

【００３１】このような電子注入電極２１を有した有機ＥＬアレイ２０の製造にあたっては、当然電子注入電極２１を形成しさらにエッチングによって凹部２１ａを形成した後、絶縁膜４の形成、およびその窓部４ａの加工を行う。そして、その上に発光層５、正孔輸送層６、透明電極７を順次形成するのであるが、絶縁膜４の窓部４ａはその内部に前記凹部２１ａが位置するように形成されるので、該凹部２１ａは窓部４ａ内にて外側（上面側）に露出することになる。したがって、発光層５は該凹部２１ａに接して形成されることにより、図３（ｂ）に示したごとくこれにも見掛け上階段状の凹部が形成される。さらに、同様にして正孔輸送層６、透明電極７にも、見掛け上の階段状凹部が形成される。

【００３２】このように電子注入電極２１に凹部２１ａを形成しておくことにより、後は通常の製造方法によって発光層５、正孔拡散層６、透明電極７にも見掛け上の凹部を形成することができる。したがって、特に絶縁膜４の窓部４ａ内に形成される発光層５が、第１の実施形態例のものに比べてその表面積自体が大きくなることから、当然その発光面積も大きくなり、これにより単位時間あたりの出射光の総量を増やすことができる。そして、このように出射光の総量を増やすことができることにより、図２に示したように集束性ロッドレンズアレイ１２を通って感光ドラム１３に集光する光の総量を増やすことができる。つまり、発光面積を大きくすることにより、感光ドラム１３に集光される単位時間あたりの光の総量を増やすことができるのである。

【００３３】このことは、図３に示したようなプリンタヘッド構成において、後述するように所望する印字を行うための発光時間を短縮することができることを意味する。ただし、発光面積を大きくするにあたっては、絶縁膜４の窓部４ａを大きくすることなく、発光面積を大きくしなければならない。なぜなら、絶縁膜４の窓部４ａを広げる（大きくする）と、隣り合うドット（窓部４ａ、４ａ）間で光の分離ができなくなる現象が起こり、このような現象が起こるとトナーの定着が隣のドットと重なり、印字品質が損なわれるからである。

【００３４】本実施形態例の有機ＥＬアレイ２０では、前述したように電子注入電極２１に凹部２１ａを形成したことにより、絶縁膜４の窓部４ａを広げることなく、発光面積を大きくした構造となっており、したがって前記の印字品質が損なわれるといった不都合を回避することができるのである。以下に、本実施形態例の有機ＥＬアレイ２０がどの程度発光時間を短縮できるかを、計算によって求めた結果を示す。

【００３５】一つの発光ドット（有機ＥＬ）、すなわち一つの窓部４ａからの単位時間あたりの出射光の総量P_tは、発光面積Ａに比例する。これを式で表すと以下のようになる。

$$P_t = a \times A \quad \cdots (1)$$

ここで、ａは単位時間、単位面積あたりの出射光の総量であり、有機ＥＬの特性によって決まる。

【００３６】ところで、電子写真方式の光プリンタにおける光源、特にＬＥＤアレイや本発明の有機ＥＬアレイにおいては、発光ドットの密度が決まればこれら発光ドットの寸法、面積がほぼ自動的に決まる。なぜなら、小さすぎては光の量自体が少なくなってしまい、また大きすぎては隣のドットまで感光させてしまう現象が起きるからである。そこで、最適な寸法で形成された発光ドットの面積をＳとして固定する。このＳは、本実施形態例では絶縁膜４の窓部４ａの面積に該当する。そして、このＳから取り出せる単位時間あたりの出射光の総量をP_sとすると、本実施形態例では、固定されたＳの中で発光面積を増やすことができることから、凹部２１ａの形成による発光面積の増加分をαとすると、出射光の総量をP_sは以下のように表せる。

$$P_s = a \times (S + \alpha) \quad \cdots (2)$$

【００３７】絶縁膜４の窓部４ａから発せられる単位時間あたりの出射光の総量P_sのうち、図２に示した集束性ロッドレンズアレイ１２を透過しさらに感光ドラム１３に照射される光の単位時間あたりの総量（以下、発光パワーと称する。）P_Dは、集束性ロッドレンズアレイ１２に入射できる確率や集束性ロッドレンズアレイ１２を透過できる確率などを考慮した効率をηとすると、以下の式で表せる。

$$P_D = P_s \times \eta \quad \cdots (3)$$

さらに、式（３）に式（２）を代入すれば、以下のようになる。

$$P_D = a \times (S + \alpha) \times \eta \quad \cdots (4)$$

【００３８】次に、発光時間をＴとすると、露光に寄与する光の総量、すなわち露光エネルギーＥは、以下の式で表わせる。

$$E = P_D \times T \quad \cdots (5)$$

式（５）に式（３）を代入すれば、以下のようになる。

$$E = P_s \times \eta \times T \quad \cdots (6)$$

式（６）に式（２）を代入すれば、以下のようになる。

$$E = a \times (S + \alpha) \times \eta \times T \quad \cdots (7)$$

これをＴについて表すと、以下となる。

$$T = E / \{a \times \eta \times (S + \alpha)\} \quad \cdots (8)$$

また、露光に寄与する光の総量、すなわち露光エネルギーＥも一定なので、以下のようになる。

$$T = K / (S + \alpha) \quad \cdots (9)$$

ここで、$K = E / (a \times \eta)$は定数である。

【００３９】次に、本実施形態例によって、発光時間がどれだけ短縮されたかを数値を用いて具体的に説明する。絶縁膜４の窓部４ａの面積（Ｓ）を、$S = 15\mu m \times 15\mu m = 225\mu m^2$、図３（ｂ）におけるＰ、Ｑの各々の一辺の長さを５μｍ、１０μｍとした。したがって、凹部２１ａによって増加した面積（α）は、

α＝１μｍ（段差）×１０μｍ（一辺長さ）×４（辺の数）＋１μｍ（段差）×５μｍ（一辺長さ）×４（辺の数）＝$60\mu m^2$

となる。

【００４０】ゆえに、$(S + \alpha) / S = 1.27$となり、発光面積が２７％増しとなる。なお、実測によると、実際の発光パワーP_Dはほぼ５０％増えていた。すなわち、式（４）の関係では面積増加分だけしか増えないものの、実際のP_Dは式（４）で表される以上に大きくなるのである。これは、発光時間Ｔは、面積効果しか示さない式（９）ではなく、実際の発光パワーP_Dにより決定されるので式（５）に従うからであると考えられる。

【００４１】このように本実施形態例の有機ＥＬアレイ２０にあっては、電子注入電極３に凹部２１ａを形成したので、これを形成しない場合に比べて発光パワーを１．５倍にすることができ、これにより発光時間を約２／３に短縮することができる。そして、発光時間を約２／３にすることができることにより、１ラインあたりの印字に必要な時間もほぼ２／３に短縮することができ、したがって単位時間あたりにどれだけ印刷できるかといった印字速度を、ほぼ１．５倍にすることができる。すなわち、本実施形態例では、電子注入電極３の形状加工のみにより、印字速度を直接的に速くすることができるのである。なお、本発明においては、凹部の形状については図３（ａ）、（ｂ）に示した形状に限定されることなく、電子注入電極３の厚さが絶縁膜４の窓部４ａの中心に向かって同心状に徐々に薄くなる形状であれば、例えば３段以上の段差を有する形状や、テーパ状に徐々に凹む形状などでもよいのはもちろんである。

【００４２】図４（ａ）、（ｂ）は、本発明の第３の実施形態例を示す図であり、これらの図において符号３０は有機ＥＬアレイである。この有機ＥＬアレイ３０が図１（ａ）、（ｂ）に示した有機ＥＬアレイ１と異なるところは、電子注入電極３１に、他の箇所に比べて厚さの薄い薄厚部３１ａが４つ形成されている点である。すなわち、本実施形態例における有機ＥＬアレイ３０の電子注入電極３１には、絶縁膜４の窓部４ａ内に位置する部分に４つの薄厚部３１ａが形成されている。薄厚部３１ａは、平面視正方形状のもので、図４（ａ）に示したように窓部４ａの四隅部に該窓部４ａの中心から均等に配置されたものである。ここで、このように４つの薄厚部

31aを中心から均等に配置した理由は、第2の実施形態例の場合と同様に、出射光の強さに方向依存性が出ないようにするためである。

【0043】電子注入電極3において薄厚部31aは、その厚さが100nmとされ、また電子注入電極3の他の箇所との段差は1μmとされている。すなわち、電子注入電極3は、薄厚部31a以外の箇所の膜厚が1．1μmに形成されているのである。なお、このような薄厚部31aについても、従来公知のホトリソグラフィ技術、およびエッチング技術によって容易に加工可能であるので、その説明を省略する。

【0044】また、このような電子注入電極21を有した有機ELアレイ20の製造にあたっては、当然電子注入電極21を形成しさらにエッチングによって凹部21aを形成した後、絶縁膜4の形成、およびその窓部4aの加工を行う。そして、その上に発光層5、正孔輸送層6、透明電極7を順次形成するのであるが、絶縁膜4の窓部4aはその内部に前記凹部21aが位置するように形成されるので、該凹部21aは窓部4a内にて外側（上面側）に露出することになる。したがって、発光層5は該凹部21aに接して形成されることにより、図3（b）に示したごとくこれにも見掛け上の凹部が形成される。さらに、同様にして正孔輸送層6、透明電極7にも、見掛け上の凹部が形成される。

＊

$$\alpha = 1\mu m\ (\text{段差}) \times 5\mu m\ (\text{一辺長さ}) \times 4\ (\text{辺の数}) \times 4\ (\text{薄厚部の数}) = 80\mu m^2$$

となる。ゆえに、（S＋α）／S＝1．36となり、発光面積が36％増しとなる。なお、実測によると、実際の発光パワーP_Dはほぼ70％増えていた。これは、第2の実施形態例の場合と同様の効果が起きているためと考えられる。

【0047】このように本実施形態例の有機ELアレイ30にあっては、電子注入電極3に薄厚部31a…を形成したので、これを形成しない場合に比べて発光パワーを1．7倍にすることができ、これにより発光時間を約3／5に短縮することができる。そして、発光時間を約3／5にすることができることにより、1ラインあたりの印字に必要な時間もほぼ3／5に短縮することができ、したがって、単位時間あたりにどれだけ印刷できるかといった印字速度を、ほぼ1．7倍にすることができる。すなわち、本実施形態例では、電子注入電極3の形状加工のみにより、印字速度を直接的に速くすることができ、しかも、4つの薄厚部31a…を一度のエッチング工程で形成することができるので、工程を簡略化することができ、これにより低コスト化を図ることもできる。なお、本発明においては、薄厚部31aの数については4つにに限定されることなく、複数であり、かつ製造上可能であればいくつでもよい。

【0048】図5（a）、（b）は、本発明の第4の実施形態例を示す図であり、これらの図において符号40は有機ELアレイである。この有機ELアレイ40が図1（a）、（b）に示した有機ELアレイ1と異なるところは、基板2と電子注入電極3との間に第2の絶縁膜41が設けられ、この第2の絶縁膜41に、その厚さが絶縁膜4の窓部4aの中心に向かって階段状に徐々に薄くなる凹部41aが設けられている点である。

【0049】すなわち、本実施形態例における有機ELアレイ40においては、電子注入電極3の形成に先立って基板2上にSiN_X膜やSiO_X膜からなる第2の絶縁膜41が形成されている。この第2の絶縁膜41には、第2の実施形態例における電子注入電極21に形成した凹部21aと同じ形状の凹部41aが形成されている。つまり、この凹部41aも前記凹部21aと同様に、絶縁膜4の窓部4aの中心に向かうに連れて第2の絶縁膜41の厚さが階段状に徐々に薄くなることによって形成されたもので、平面視正方形状の凹部が二段階に凹んで形成され、かつこれら二段階の凹みが窓部4aの中心に対して同心状に形成されたものである。そして、電子注入電極3は、このような凹部41aを形成した第2の絶縁膜41上に形成されることにより、該凹部41aの形状に沿った形状のものとなっている。

【0050】なお、この凹部41aにおいても、図5（a）、（b）中Pで示す平面視正方形状の領域が中心部であって最も薄く形成された部分となり、このP領域の外側の領域、すなわち図5（a）、（b）中Qで示す平面視正方形枠状の領域が次に薄く形成された部分となっている。そして、本実施形態例では、第2の実施形態例における凹部21aと同様に、Pで示す領域の膜厚を100nmとし、凹部41a内における階段の一段あたりの段差を1μmとした。よって、第2の絶縁膜41の最も厚い部分の膜厚は2．1μmとなり、Qで示す領域の膜厚は1．1μmとなる。このような階段状の凹部41aの形状については、従来公知のホトリソグラフィ技術、およびエッチング技術によって容易に加工可能であるので、その説明を省略する。また、凹部41aを同心状に凹ませる理由は、第2の実施形態例と同様に出射光の強さに方向依存性が出ないようにするためである。

【0051】このような第2の絶縁膜41を有した有機ELアレイ40の製造にあたっては、前述したように第2の絶縁膜41を形成しさらにエッチングによって凹部41aを形成した後、電子注入電極3の形成、絶縁膜4の形成、およびその窓部4aの加工を行う。このとき、電子注入電極3は該凹部41aに接して形成されることにより、図5（b）に示したごとくこれにも見掛け上階段状の凹部が形成される。次いで、絶縁膜4の上に発光層5、正孔輸送層6、透明電極7を順次形成するのであるが、絶縁膜4の窓部4aはその内部に前記凹部41aが位置するように形成されるので、該凹部41aの上に形成された電子注入電極3の見掛け上の凹部は、窓部4a内にて外側（上面側）に露出することになる。したがって、発光層5、正孔輸送層6、透明電極7にも、それぞれ見掛け上の階段状凹部が形成される。

【0052】このように第2の絶縁膜41に凹部41aを形成しておくことにより、後は通常の製造方法によって電子注入電極3、発光層5、正孔拡散層6、透明電極7にも見掛け上の凹部を形成することができる。したがって、特に絶縁膜4の窓部4a内に形成される発光層5が、凹部41aの形状に対応した階段状形状となることにより、第1の実施形態例のものに比べてその表面積自体が大きくなる。よって、この実施形態例のものにあっても、当然その発光面積が大きくなることから、単位時間あたりの出射光の総量を増やすことができ、これにより図2に示した構成において感光ドラム13に集光される単位時間あたりの光の総量を増やすことができるのである。

【0053】なお、発光層5や正孔輸送層6は段差のある部分で結晶化し易く、これらは一旦結晶化するとその結晶領域が広がる。そして、これが発光領域にまで侵入するとその部分は発光しないダークスポットとなり、点欠陥を形成するものとなって印字品質を著しく損ねてしまう。よって、不必要な段差形状は極力付与しないのが望ましいのである。本実施形態例では、発光面積を大きくする必要のある絶縁膜の窓部4内のみに凹凸形状を形成しているので、発光層5や正孔輸送層6の結晶化に伴う点欠陥の形成を最小限に抑え、歩留りの向上を図ることができる。

【0054】以下に、第2の実施形態例の場合と同様に、本実施形態例の有機ELアレイ40がどの程度発光時間を短縮できるかを、数値を用いた計算によって具体的に求めた結果を示す。絶縁膜4の窓部4aの面積（S）を、S＝15μm×15μm＝225μm^2、図5（b）中におけるP、Qの各々の一辺の長さを5μm、10μmとした。したがって、凹部41aによって増加した面積（α）は、

$$\alpha = 1\mu m\ (\text{段差}) \times 10\mu m\ (\text{一辺長さ}) \times 4\ (\text{辺の数}) + 1\mu m\ (\text{段差}) \times 5\mu m\ (\text{一辺長さ}) \times 4\ (\text{辺の数}) = 60\mu m^2$$

となる。ゆえに、（S＋α）／S＝1．27となり、発光面積が27％増しとなる。なお、実測によると、実際の発光パワーP_Dはほぼ50％増えていた。これは、第2の実施形態例の場合と同様の効果が起きているためと考えられる。

【0055】このように本実施形態例の有機ELアレイ40にあっては、第2の絶縁膜41に凹部41aを形成したので、これを形成しない場合に比べて発光パワーを1．5倍にすることができ、これにより発光時間を約2／3に短縮することができる。そして、発光時間を約2／3にすることができることにより、1ラインあたりの印字に必要な時間もほぼ2／3に短縮することができ、したがって、単位時間あたりにどれだけ印刷できるかといった印字速度を、ほぼ1．5倍にすることができる。すなわち、本実施形態例では、電子注入電極3の形状加工のみにより、印字速度を直接的に速くすることができるのである。なお、本発明においては、凹部の形状については図5（a）、（b）に示した形状に限定されることなく、第2の絶縁膜4の厚さが絶縁膜4の窓部4aの中心に向かって同心状に徐々に薄くなる形状であれば、例えば3段以上の段差を有する形状や、テーパ状に徐々に凹む形状などでもよいのはもちろんである。

【0056】図6（a）、（b）は、本発明の第5の実施形態例を示す図であり、これらの図において符号50は有機ELアレイである。この有機ELアレイ50が図1（a）、（b）に示した有機ELアレイ1と異なるところは、絶縁膜4の窓部4a内に位置する部分に、各電子注入電極3および該窓部4aを形成する絶縁膜4の側面を覆って第2の電子注入電極51が設けられ、発光層5が、該第2の電子注入電極51を覆って形成されている点である。

【0057】すなわち、本実施形態例における有機ELアレイ50においては、電子注入電極3形成し、さらに絶縁膜4とその窓部4aを形成した後、電子注入電極3に接してこれを覆い、かつ窓部4aを形成する絶縁膜4の側面に接してこれを覆うとともに、該窓部4aの周辺部分の絶縁膜4をも覆って第2の電子注入電極51を形

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成している。この第２の電子注入電極５１としては、発光層５への電子注入が容易なよう仕事関数が低いものが好ましく、具体的にはＭｇＡｇ合金、Ｉｎ、ＭｇＩｎ合金、ＭｇＣｕ合金、ＭｇＬｉ合金などが好適とされ、本例ではＭｇＡｇ合金が用いられてこれが厚さ１００ｎｍに形成されている。ただし、本実施形態例においては、電子注入電極３については発光層５への電子注入にほとんど関係しなくなることから、仕事関数が低いものとする必要がなく、したがってＡｌを用いている。

【００５８】本実施形態例の有機ＥＬアレイ５０にあっては、第２の電子注入電極５１を、各電子注入電極３および窓部４ａを形成する絶縁膜４の側面を覆って形成したので、特に窓部４ａ内において光漏れを起こす絶縁膜４の窓部４ａ側面においても、これが第２の電子注入電極５１で覆われていることにより、発生した光が該側面で漏れることなく反射し、出射光として取り出される。その結果、出射光の総量P_Sを大きくすることができるのである。

【００５９】以下に、第２の実施形態例の場合と同様に、本実施形態例の有機ＥＬアレイ５０がどの程度発光時間を短縮できるかを、数値を用いた計算によって具体的に求めた結果を示す。第２の電子注入電極５１により、新たに反射されて出射光として外部に取り出せる光の量は、以下の反射面積増大分βに相当する。

反射面積増大分β＝０．３μｍ（絶縁膜の厚み）×１５μｍ（窓部の一辺長さ）×４（辺の数）＝１８μm^2

ここで、反射面積をβだけ増やした場合に得られる発光パワーをP_{D2}とすると、P_{D2}は以下のようになる。

$P_{D2}=P_D\ (S+\beta)/S=1.08P$

発光面積は変わらないものの、反射面積が８％増しとなる。なお、実測によると、実際の発光パワーP_{D2}はほぼ２０％増えていた。ここで、注目すべきは発光面積が変わっていない点である。発光面積が大きくなれば、発光パワーも上がるが、そのかわりに供給電流も増やさねばならない。しかし、本実施形態例では、発光面積を大きくすることなく発光パワーを上げられるので、供給電流を増やすことなく、発光パワーを上げる事が出来るのである。

【００６０】このように本実施形態例の有機ＥＬアレイ５０にあっては、第２の電子注入電極５１を、各電子注入電極３および窓部４ａを形成する絶縁膜４の側面を覆って形成したので、これを形成しない場合に比べて発光パワーを１．２倍にすることができ、これにより発光時間を約４／５に短縮することができる。そして、発光時間を約４／５にすることができることにより、１ラインあたりの印字に必要な時間もほぼ４／５に短縮することができ、したがって、単位時間あたりにどれだけ印刷できるかといった印字速度を、ほぼ１．２倍にすることができる。また、本実施形態例では、供給電流を増やすことなく発光パワーを上げられるので、発光効率を向上

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することができ、これにより消費電流の低減化を図ることができる。

【００６１】

【発明の効果】以上説明したように本発明の有機ＥＬアレイは、絶縁性基板上に一括して作製可能なものであるから、従来のＬＥＤアレイのごとくＬＥＤチップを多数一直線上に配列させるといった実装上の困難さを回避することができ、これにより低コスト化を図ることができる。また、絶縁膜の窓部を形成した側、すなわち絶縁性基板の上面側から光を取り出す構造としたので、例えばガラスからなる基板の裏面から光を取り出す場合に起こる、ガラス裏面における全反射による光の損失や、ガラスへの吸収による光の損失をなくして光を効率良く外部に取り出すことができ、これにより短時間で強い光を取り出せることからプリンタによる印字の高速化を可能にすることができる。

【図面の簡単な説明】

【図１】（ａ）、（ｂ）は本発明における有機ＥＬアレイの第１の実施形態例の概略構成を示す図であり、（ａ）は平面図、（ｂ）は（ａ）のＢ－Ｂ線矢視断面図である。

【図２】図１に示した有機ＥＬアレイを用いたプリントヘッドの概略構成図である。

【図３】（ａ）、（ｂ）は本発明における有機ＥＬアレイの第２の実施形態例の概略構成を示す図であり、（ａ）は平面図、（ｂ）は（ａ）のＢ－Ｂ線矢視断面図である。

【図４】（ａ）、（ｂ）は本発明における有機ＥＬアレイの第３の実施形態例の概略構成を示す図であり、（ａ）は平面図、（ｂ）は（ａ）のＢ－Ｂ線矢視断面図である。

【図５】（ａ）、（ｂ）、（ｃ）は本発明における有機ＥＬアレイの第４の実施形態例の概略構成を示す図であり、（ａ）は平面図、（ｂ）は（ａ）のＢ－Ｂ線矢視断面図、（ｃ）は（ａ）のＣ－Ｃ線矢視断面図である。

【図６】（ａ）、（ｂ）は本発明における有機ＥＬアレイの第５の実施形態例の概略構成を示す図であり、（ａ）は平面図、（ｂ）は（ａ）のＢ－Ｂ線矢視断面図である。

【符号の説明】

１、２０、３０、４０、５０　有機ＥＬアレイ
２　基板
３、２１、３１　電子注入電極
４　絶縁膜
４ａ　窓部
５　発光層
６　正孔輸送層
７　透明電極
２１ａ　凹部
３１ａ　薄厚部

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４１　第２の絶縁膜
４１ａ　凹部

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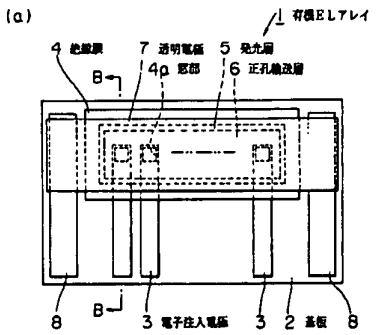
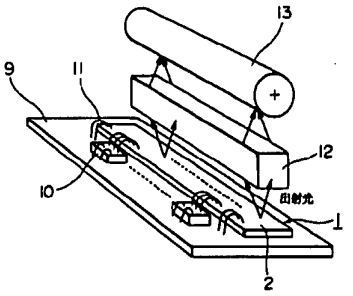
５１　第２の電子注入電極

【図１】



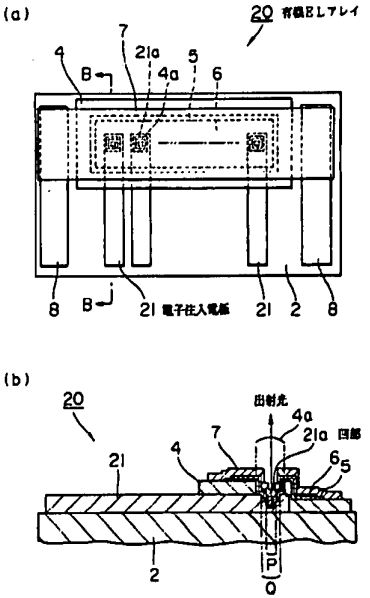
第１の実施形態例の概略構成図

【図２】



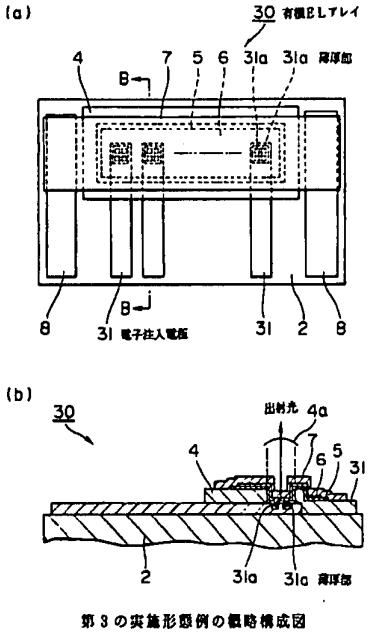
プリントヘッドの概略構成図

【図３】



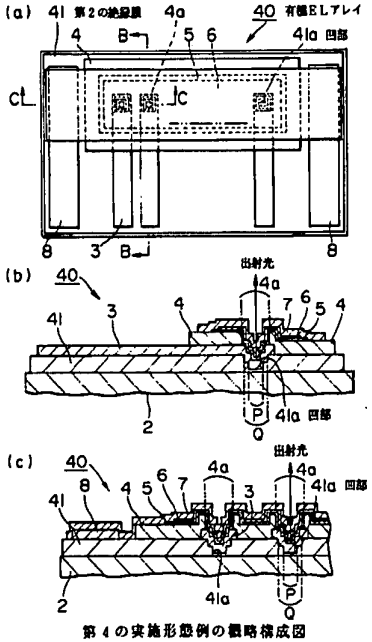
第２の実施形態例の概略構成図

【図4】



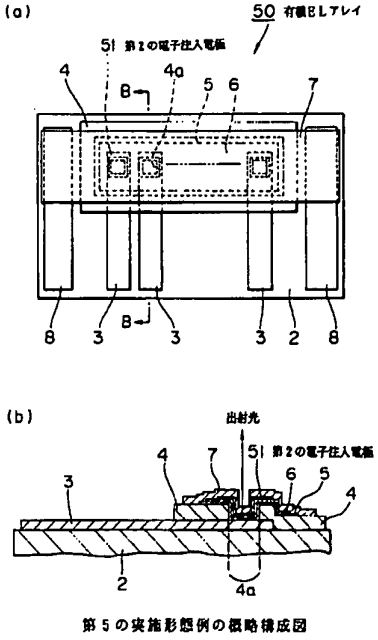
第3の実施形態例の概略構成図

【図5】



第4の実施形態例の概略構成図

【図6】



第5の実施形態例の概略構成図

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